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## THE THREE-RATE SYSTEM OF CHARGES.

In this issue will be found the first installment of an article dealing with the three-rate system of charging for electric power. Considerable attention has been devoted to the question of rates recently and this contribution by Mr. Hugo E. Eisenmenger will be found to throw considerable light upon the whole subject and to make clear many points which must influence the entire question of rates. Mr. Eisenmenger has attacked the problem from the geometrical standpoint and his diagrams in three dimensions should be very helpful in forming a conception of the way in which the three elements of cost influence the total expenses and the way in which these elements should enter into the fixing of rates. It also presents in a way more clear than any heretofore brought forward, the manner in which any change in rates will affect the general relation of different classes of customers to the companies supplying the power. This paper will undoubtedly come to be recognized as a classic on this subject.

One of the questions which is suggested by Mr. Eisenmenger's contribution, but which is not discussed in detail by him, is in regard to the basis upon which profits should be figured in the case of a public-service corporation. There are two principal ways in which the percentage of profits may be estimated. One of these is upon the amount of the investment, in which case the percentage profit is simply the difference between the actual return and the percentage which may be regarded as a proper interest return upon the capital. The other way of looking at profits is as a percentage upon the total amount of business transacted, in which case it must be figured upon the basis of gross receipts. If a certain percentage of profits is determined as a proper return to the stockholders, according to the first point of view this will be fixed as soon as the amount of capital is determined, whereas according to the second point of view the amount of profits will vary with the amount of business transacted. In this case the opportunity for profits is an incentive for an increase of business.

In connection with the regulation of rates of public-utility companies by law, the method of allowing profits may become of considerable importance. Mr. Eisenmenger has assumed that profits are based upon the gross receipts of the company and that consequently these gross receipts

must bear a ratio to the cost of operation, including fixed charges, which involves the factor of profit. This simplifies very much the relation between rates and the expense of operation.

## ELECTRIC VEHICLES FOR 1911.

The display of electric pleasure vehicles of numerous makes and types at the 1911 Chicago Automobile Show impressively demonstrates the magnitude to which this branch of the automobile industry has grown and the favor with which the public is receiving electrically propelled vehicles.

The electric-vehicle manufacturers should be—and most of them are—prepared to admit that there is a field of usefulness for the gasoline car in which the electric car does not trespass. However, with the higher standards of today that are governing electric-vehicle designing and construction, this field has been materially reduced and the range of service and usefulness of the electric vehicle greatly broadened. In fact, round-trip suburban journeys of sixty to ninety miles are no longer unusual, given reasonably good road conditions.

Absurd claims of mileage secured under ideal running conditions and at speeds so slow as to make them impractical are a detriment to the advancement of the electric and not necessary to substantiate the claims of the electric for favorable consideration, as their mileage is ample to take care of all of the requirements of the average car user.

The great variety of uses to which the commercial electric vehicle is being put was strikingly shown at the Commercial Motor Vehicle Exhibition held in Chicago at the close of the Automobile Show; for aside from the impressive exhibit of heavy trucks for carrying coal, and other heavy freight, there were ambulance wagons, fire engines, police patrol wagons, and delivery wagons designed for a wide range of uses. The important section of the exhibit space reserved for electric vehicles gave striking proof that the storage battery is making a bold bid for recognition, not merely in the field of pleasure vehicles, but also for heavy commercial work.

In recent months a new battery has come into practical use and has had its influence upon the design and construction of the latest models—an influence destined, no doubt, to increase with time. A noticeable improvement has also been made in one of the standard batteries which insures lighter weight and greater life than heretofore.

Perhaps the most marked impression left by the show is a sense of the high character of the mechanical work, both as regards the care and intelligence shown in the design and the excellence of the materials and workmanship. Brief descriptions of the technical features of a number of standard electric vehicles for 1911 appear on other pages of this issue.

## THE STRETCHING OF A CONDUCTOR BY ITS CURRENT.

In the January issue of the *Journal of the Franklin Institute* there is an article by Mr. Carl Hering entitled "The Stretching of a Conductor by its Current," which is given in abstract in this issue. Mr. Hering gives reasons for believing that there is a force in a conductor tending to separate the longitudinal elements of the conductor. In a number of experiments which have been cited to demonstrate this fact, but which are not included in the abstract, the result obtained could in every case be explained by a transverse force such as is generally considered to act upon a conductor when carrying a current in a magnetic field. The electric motor forms the most apt illustration of this force.

It is a well known principle that there is a force upon every current-carrying circuit tending to make it move in such a direction as to inclose a greater amount of magnetic flux. A ring for instance is, when carrying a current, subjected to a force tending to increase its diameter, thus to stretch it, but this effect is readily accounted for by such a transverse force as above mentioned. The case is analogous to the stretching of a boiler by the pressure within, normal to the surface.

In Ampère's classical work upon the mutual action of currents he derived an expression for the force between any two elements of a circuit carrying current and in the case where these two elements are in the same straight line his differential expression does not reduce to zero, but indicates a repulsive force. Whether or not Ampère's differential expression is a correct one has never been demonstrated as it is impossible experimentally to measure the force between two elements of a circuit. In order for current to flow we must have a complete circuit and the action of the different elements of this complete circuit upon an element of some other circuit or upon themselves cannot be separated. While Ampère's expression gives a correct result when integrated over an entire circuit, it is doubtful whether it is correct for the individual elements. This is all the more apparent since Neumann and others have given other differential expressions which will also give correct results when integrated over an entire circuit and such an expression can be chosen so that the force reduces to zero for two elements lying in the same straight line of flow.

Viewing the matter from the standpoint of the conservation of energy such a force as Mr. Hering stipulates would be possible if any motion resulting from the stretching force increased the magnetic flux linking the circuit, and thus induced a counter electromotive force corresponding to the amount of energy involved. If the application of such a proposed law is limited to cases in which the circuit is increased it would thus seem reasonable, but in the form given by Ampère the existence of such a repulsion does not depend upon the resulting form of circuit and must exist

in cases where the motion of the parts would not have any influence upon the flux. Since in this case no counter electromotive force would be generated, there would seem to be a contradiction to the law of the conservation of energy and consequently we cannot believe that Ampère's formula is in agreement with the facts.

Since a moving charge is equivalent to an electrical current it might seem possible to determine the question here at issue by experiments upon the particles constituting cathode rays or the beta rays from radium. It might be possible to detect such repulsive forces in a stream of such charged particles. There is one way, however, in which this convection current may differ from the ordinary conduction current. This is owing to the fact that the cathode rays and the beta rays are made up of negative particles alone, or electrons. Electrostatic forces would naturally be expected to exist between these charges or electrons. In a metallic conductor carrying current, however, it is believed according to the electron theory that both positive and negative charges are present, but that the current is due to the motion of the negative particles or electrons alone. Consequently no electrostatic forces would be called into play in this case, but any existing forces must be purely electromagnetic in character. In view of these conditions it does not seem possible to elucidate the question brought up by Mr. Hering by any experiments upon charged particles in motion.

## ELECTRICAL EXPORTS FROM THE UNITED STATES.

The trend of the electrical exports of the United States during the past year is excellently shown by tabulated data on another page of this issue. While the figures there given speak for themselves, some interesting facts that are not at once evident are brought out upon an analysis of them.

From the annual totals of the last four years it is seen that the electrical exports in 1910 came within one-half million dollars of the record year 1907. This in itself is cause for gratification in view of the marked falling off that was experienced in the two intervening years. Had the first few months of 1910 been up to the strong level that was maintained throughout the rest of the year, there would have been established a new annual record. However, the present indications are that next year will develop some pleasantly surprising totals for American exporters of electrical products.

A significant change in the character of electrical exports has taken place in the last two years. Whereas the exports of machinery and heavy apparatus have always held the lead, in 1909 there developed a strong foreign trade in the lighter appliances, including chiefly telephonic equipment, so that during the past year the total of appliance exports exceeded not only the total machinery shipments, as it had in 1909, but even the record machinery total of 1907. The month of May, 1910, alone showed the high total of over one million dollars in appliance exports.

These are simple but forcible tributes to the excellence of American telephone apparatus and point to our mastery of the world's trade in that line. The telephone has received its greatest development in this country and now that the rest of the world is becoming acquainted with its value it must naturally look to American manufacturers to supply the best equipment.

In the electrical machinery trade, on the other hand, our manufacturers have to meet the very sharp competition of German and other foreign makers. Even at that the machinery exports to our neighbors, Canada and Mexico, have quite steadily increased. To some countries, however, notably Brazil, our machinery shipments have steadily decreased during the last three years, whereas the appliance shipments have in the same period nearly doubled. A strong movement is now under way to combat the foreign trade in what should be our natural markets in South America and Central America. It is to be hoped that as an outcome of it our exports of electrical machinery will again be brought to the high level established in 1907.

## PUBLIC-SERVICE COMMISSIONS.

At the meeting of the Western Society of Engineers, held February 1, an account of which appears on other pages of this issue, the question of the establishment of a public-service commission was presented in a paper dealing with this subject.

Through logical reasoning it was shown that a public-service company should be granted a monopoly in the city in which it operates; the effects incident to competition and the uncertainty of the future would be eliminated and a corporation would not feel the necessity of accumulating surplus, which might be necessary under other conditions. However, to deal with the questions that might arise subsequent to the granting of a monopoly there should be established a commission composed of technical men.

In the paper it was advocated that there be established a commission for each character of service so that a single commission would not have to be burdened with the problems of all utilities. It would seem that while this plan has several advantages, it would result in confusion and dissatisfaction due to each commission deciding questions, no doubt fairly and honestly, but without regard to the decisions of other commissions. It of course happens that similar questions, particularly regarding rates and franchises, would come before the independent commissions and it is readily apparent that if conflicting decisions were rendered the results would be prejudicial to the object of the commissions. It is, however, generally agreed that a commission should be a state-wide one. At present Illinois has no State Commission.

**American Institute Reception and Ball.**

For some years past it has been the custom for the American Institute of Electrical Engineers to hold an annual dinner, which has usually been made the occasion of some special feature. At the meeting of the Board of Directors, held on January 13, 1911, it was decided that the annual function this year shall be in the form of a reception and ball, which will be held in the grand ballroom of the Hotel Astor, New York City, on Tuesday evening, February 28, 1911, at nine o'clock. The price of tickets is $2.50 per person, which will include supper. Applications for tickets should be sent to Institute headquarters, 33 West Thirty-ninth Street, New York City, accompanied by cash, or check payable to R. W. Pope.

A prominent feature of this function will be the presentation of the past-presidents' badges, and it is expected that most of the past-presidents will be present. The idea of conferring upon outgoing presidents of the Institute a badge or insignia of office in commemoration of the services rendered by them to the Institute has been under consideration for over a year, and the proposed presentation is the result of the work of the special committee appointed to consider and report upon the matter.

**The American Institute of Consulting Engineers.**

The annual meeting of the American Institute of Consulting Engineers was held at the Engineers' Club, New York City, January 17. The following officers were elected for the ensuing year: President, Alfred P. Boller; vice-president, Gustav Lindenthal; secretary and treasurer, Eugene W. Stern, 103 Park Avenue, New York City.

Committees were appointed on admissions, on professional practice and ethics, and on legislation.

**Pan-American Commercial Conference.**

A Pan-American Commercial Conference is to be held in Washington, February 13-18. It is estimated that the total attendance will be in the neighborhood of 600.

Probably no one factor has contributed more to foreign countries taking the lead over the United States in the amount of goods shipped into the Latin American republics than the system of credits to which American merchants in a large degree have adhered, and this will be one of the chief points of discussion.

This system is the outgrowth of a demand, generally, on the part of American merchants that goods be paid for before being shipped. While it does not prevail to the extent that it once did, it is still sufficiently in force to give competitive merchants in Germany and Great Britain, who are satisfied to receive payment upon delivery, a decided advantage over American shippers.

**Minneapolis Rejuvenation of the Sons of Jove.**

A rejuvenation and joviation was held by the Sons of Jove, in Minneapolis, on February 3, under the direction of Henry C. Bentz, statesman for Minnesota, P. F. Lyons of Chicago, statesman-at-large, and E. D. Strickland.

Thirteen candidates were entered into the order and after the initiation, which took place at the Royal Arcanum Hall, a well prepared dinner was served at the Kaiserhof. Henry Bentz was toastmaster at the dinner and there were present about thirty members in all. C. L. Pillsbury made an excellent address on the closer co-operation of electrical men throughout the country, and particularly in the Northwest, where it seems to be needed at the present time. Following this, all members were called upon for one-minute talks.

**Train Dispatching by Telephone on Chicago & Western Indiana Railway.**

Following the lead of many of the largest railroads in the United States, which have decided that the telephone has greater advantages in the way of safety, speed and economy than the telegraph for the important work of train dispatching, the Chicago & Western Indiana Railway has just ordered a complete equipment of railway telephone material. The new dispatching system will cover the entire line of this road and of the Belt Railway of Chicago.

There will be three circuits. One is the train-dispatching wire of the Chicago & Western Indiana lines, another the train-dispatching wire of the Belt Railway and the third a message circuit paralleling the train-wire circuit of both roads. A total of fifty-five way-station telephone outfits and 104 selector outfits will be provided.

Wires are now being strung by the railroad company. The best grade of copper wire is being used. The selectors to be furnished with this equipment are the new Western Electric local-battery type, which are being used extensively by a number of the large truck lines.

**Electrical Exports for December and for the Year 1910.**

The Bureau of Statistics of the Department of Commerce and Labor, Washington, D. C., has completed its monthly summary of the imports and exports of the United States for December, 1910, and therefore also its annual summary for the calendar year 1910. From these statistics the following facts are taken relative to the electrical exports.

The figures for the month of December did not differ very greatly from those of the preceding month, but were a marked improvement over those of a year ago. The year as a whole showed a resumption of exports nearly to the record total of 1907. In fact, the exports of electrical appliances (chiefly telephone equipment) broke all previous annual records. The comparative monthly data are clearly shown by the following table of values of electrical exports for the twelve months of 1910 and for December, 1909:

| Month | Electrical Appliances | Electrical Machinery | Total Electrical Exports |
|---|---|---|---|
| December, 1909.. | $ 681,868 | $461,149 | $1,143,017 |
| January, 1910.... | 621,469 | 565,838 | 1,187,307 |
| February, 1910... | 607,359 | 331,136 | 938,495 |
| March, 1910..... | 783,371 | 699,261 | 1,482,632 |
| April, 1910..... | 959,186 | 484,658 | 1,443,844 |
| May, 1910..... | 1,025,549 | 684,938 | 1,710,487 |
| June, 1910..... | 902,593 | 586,202 | 1,488,795 |
| July, 1910..... | 839,059 | 745,419 | 1,584,478 |
| August, 1910..... | 852,958 | 708,160 | 1,561,118 |
| September, 1910.. | 762,152 | 578,246 | 1,340,398 |
| October, 1910..... | 780,233 | 514,184 | 1,294,417 |
| November, 1910.. | 884,326 | 612,007 | 1,496,333 |
| December, 1910... | 826,183 | 646,639 | 1,472,822 |

The comparative totals for the last four years are shown by this interesting table:

| Year | Electrical Appliances | Electrical Machinery | Total Electrical Exports |
|---|---|---|---|
| 1907 ..... | $7,725,545 | $9,735,230 | $17,460,775 |
| 1908 ..... | 5,657,008 | 6,956,722 | 12,613,730 |
| 1909 ..... | 7,063,804 | 5,963,746 | 13,027,550 |
| 1910 ..... | 9,844,438 | 7,156,688 | 17,001,126 |

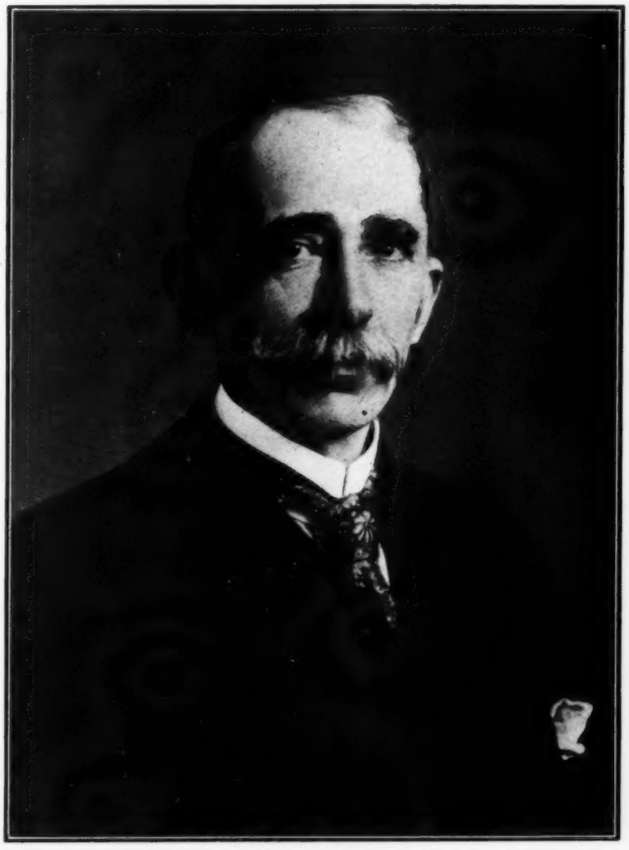
Referring again to the detailed figures for the month of December, 1910, a list of the principal countries to which electrical products were sent, together with the value of these exports, is given below:

| Exported to | Electrical Appliances | Electrical Machinery |
|---|---|---|
| United Kingdom..... | $ 49,050 | $ 52,616 |
| Canada ..... | 247,313 | 144,949 |
| Mexico ..... | 90,274 | 164,018 |
| Cuba ..... | 50,839 | 17,396 |
| Brazil ..... | 169,110 | 24,850 |
| Japan ..... | 39,362 | 105,540 |

### John Ambrose Fleming.

A study of the career of John Ambrose Fleming, the subject of this sketch, reveals a character of extremely useful versatility. Here is a man who is not only patient, methodical and practical in research, but also brilliant in instruction and in the elucidation of highly technical problems for the enlightenment of those less gifted. He is also the masterful leader and executive, and a combination of these three rare qualities mark him as a distinguished man among men of science and accomplishment.

John Ambrose Fleming was born at Lancester, England, November 29, 1849, the son of the Rev. James Fleming, D. D. He entered University College School, London, at an early age and later prepared for the profession of engineering at University College, from which he graduated in 1870 as Bachelor of Science. He spent two years as a student at the Normal School of Science at South Kensington. In 1873 and 1874 he was a demonstrator in the laboratories in the Royal College of Chemistry, as well as private assistant to the late Sir Edward Frankland. Upon the founding of the Physical Society of London he read the first paper presented before that body, on the subject of "The New Contact Theory of the Galvanic Cell." In 1874 he was appointed science master and special lecturer of physics and chemistry in the Military Department of Cheltenham College, resigning early in 1877 to enter Cambridge University.



JOHN A FLEMING,
Hughes Gold Medalist for 1910.

While continuing his post graduate studies in the Cavendish Laboratory he carried on a long line of research work, designing a special form of bridge and making an elaborate investigation and report upon the British Association's standards of resistance.

He was elected successively Exhibitioner in Natural Science, 1877, at St. Johns College and also Foundation scholar of the College in 1879, also Hare Exhibitioner Wright's Prizeman and Hughes' Prizeman, the last being a special award annually conferred upon the Foundation Scholar who had most distinguished himself in mathematics and natural philosophy.

In 1879 Professor Fleming took the degree of Doctor of Science in the University of London, and the degree of Bachelor of Arts at Cambridge University. In 1880 he was appointed University demonstrator in mechanics and applied science. When University College at Nottingham was opened in 1881, Dr. Fleming was selected as the first occupant of the newly-founded chair of mathematics and physics. It was in this year that he resigned his professorship in order to move to London where upon the organization of the Edison Electric Light Company, in 1882, he was appointed electrical engineer. On the amalgamation of the Edison and Swan interests in 1883 he became advising electrician to the new concern and was naturally connected prominently with the introduction of incandescent lighting.

In 1885 he was appointed to the newly created chair of electrical engineer at University College, at London, in addition to continuing his other professional work. Since 1885 he has been engaged in laborious research work and in many notable investigations.

When the friends of the late Sir John Pender endowed a memorial chair of electrical engineering at University College, London, in 1897, it was with the condition that Dr. Fleming occupy the Pender chair of electrical engineering.

His interest in popular education resulted in the establishment of the Morley Memorial College, Waterloo Bridge Road, London. Since 1899, Dr. Fleming has been scientific advisor of the Marconi Wireless Telegraph Company, and of late he has held the post of department editor for electricity in connection with the eleventh edition of the Encyclopedia Brittanica. To this work he has contributed no less than twenty-five articles. He is the author of many scientific papers which have led to the establishment of standardizing laboratories. His paper on "Photometry of Electric Lamps" was awarded the Institution Premium by the Institution of Electrical Engineers of Great Britain. His Cantor lectures at the Society of Arts have been widely translated and republished.

At the anniversary meeting of the Royal Society, held in London, November 30, 1910, he was presented with the Hughes gold medal.

Dr. Fleming was elected a Fellow of St. Johns College, Cambridge, in 1883, a Fellow of University College, London, in 1884, and a Fellow of the English Royal Society in 1892. He is also a member of the Royal Institution of Great Britain and has been vice-president of both the Institution of Electrical Engineers and the Physical Society of London.

### New York Central Extends Electric Service.

The electric service on the Hudson River division of the New York Central, has now been extended to Hastings, N. Y. This shortens the running time between the Grand Central Station and Hastings by two minutes.

### Chicago Electric Club.

The meeting of the Chicago Electric Club on Wednesday, February 1, was devoted to the election of officers for the ensuing year and to miscellaneous business. The slate proposed by the nominating committee was unanimously carried, the following officers being declared duly elected: President, Homer E. Niesz, general manager, Cosmopolitan Electric Company; vice-president, C. A. Howe, district manager, Holophane Company; secretary, N. F. Obright, contract agent, Sanitary District; treasurer, Otis B. Duncan, J. Lang Electric Company. For the Board of Managers: J. W. Mabbs, H. A. Mott, A. L. Millard, George H. Jones and W. R. Bonham.

Brief remarks, appropriate to the occasion, were made by the retiring and incoming officers. The report of the treasurer shows the Club to have a balance on hand of $3,260 as compared with $2,094 last year. Fifty-one new members were added during the year, making a total of 332 active members as compared to 423 last year.

A vote of thanks was extended the Guarantee Electric Company and E. B. Rockwell and Edwin H. Frank of that firm for their assistance during the year in sending out the weekly notices of meetings.

### Industrial Accidents.

Industrial accidents in the United States take an annual toll of life and limb far exceeding the killed and wounded of several great military campaigns, says John Calder in a paper read before the American Society of Mechanical Engineers. The yearly mortality is over 30,000, and the non-fatal injuries inflicted will roll up the total by at least an additional 2,000,000. Prevention is the theme of the paper, which analyzes the causes of those accidents regarded as preventable and describes various devices for guarding equipment and processes, drawn chiefly from the writer's experience in plant management. Mr. Calder considers that one-third of the present rate of mortality can and should be eliminated by such devices.

The causes of preventable accident are, in Mr. Calder's belief, chiefly ten—ignorance, carelessness, unsuitable clothing, insufficient lighting, dirty and obstructed workplaces, defects of machinery and structure, and absence of safeguards—and with each of these he deals in turn, showing how they may be eliminated. Engineers are largely responsible in these cases, since to them usually falls the control of such plants, and the matter should be made one of scientific study by them.

Safeguards, where at all possible, should be constructed of metal to secure durability. Reinforced steel mesh work is preferred by the author for all but the heaviest machinery. It is superior to guards of opaque material, since it permits easy inspection without detaching the safeguard and interferes as little as possible with lighting conditions. In steel mills, foundries and heavy-work plants of various descriptions, where the wear and tear of equipment is very great, nothing but strong castings or steel plate work should be used for the majority of the guards. It is the practice of the author to have all safeguards readily distinguished by painting the body of them vermillion and the reinforced edges black. This allows executives to detect at a glance in going through the shops a displaced or defective guard, such parts being often small in area, in inconspicuous places, and liable to be overlooked.

### Toronto Dinner.

The Toronto Electric Light Company's employes held their annual dinner on Friday, February 3. Charles Moseley, chief engineer of the steam plant, presided. Toasts were responded to by William Dent for the wiremen, Thomas Wright for the plant employes, Eugene Creed for the salesmen, and W. F. McCann for the engineers.

The entertainment was furnished by Messrs. Gaiger, Dayton, Bedford, Buckley, Levison, Jackson, Ellis, Smith and Pace, all employes of the Company with the exception of Mr. Dayton.

### New Zealand Hydroelectric Projects.

A bill has been enacted into law in New Zealand authorizing the government to establish three hydroelectric plants, each to develop 10,000 horsepower. Each locality concerned—Auckland, Christchurch and Wellington— has already a municipally owned electric lighting plant using coal at about $5.000 per ton, and the government projects will come into competition with these.

### Philadelphia Electric Show.

It is believed by the managers that the Electric Show to be held in Philadelphia, February 13 to 27, will form one of the most complete exhibitions of this character ever held.

The three great electric public-service corporations in the city, the Philadelphia Electric Company, the Philadelphia Rapid Transit Company and the Keystone Telephone Company, are taking an active part in the exhibition, and the City of Philadelphia will also have an exhibit. The great educational institution of the state—the University of Pennsylvania—will have an exhibit, as will also the historic Franklin Institute, the Spring Garden Institute, and the International Correspondence Schools. The Philadelphia Electrical Contractors' Association will exhibit as an association. Over fifty companies have already taken space.

Philadelphia is practically an untouched field for the electric vehicle, for both commercial and pleasure purposes. Many new agencies recently established are enthusiastic over future prospects, and it is expected that many types of these up-to-date cars will be shown in the exhibition.

### New Detroit-Ann Arbor Branch of the American Institute.

At an enthusiastic meeting held at the Hotel Tuller in Detroit, Mich., January 28, a new branch of the American Institute of Electrical Engineers was organized. The initial membership of forty-eight is divided between Detroit, Ann Arbor and Jackson. Meetings will be held once a month, alternating between Detroit and Ann Arbor. The following officers were elected: chairman, C. L. de Muralt, professor of electrical engineering at the University of Michigan; vice-chairman, H. M. Browne of Detroit; secretary-treasurer, B. F. Bailey, Ann Arbor; assistant secretary-treasurer, J. J. Woolfenden, Detroit.

The next meeting will be held in Ann Arbor, and will be of a social nature, the princial feature being a dinner given by the Ann Arbor members to those of Detroit, Jackson and elsewhere. After dinner Professor de-Muralt, the newly elected chairman, will give an address on "Some Recent Aspects of Railway Electrification." All close enough to Ann Arbor to attend are cordially invited.

# Light, Heat and Power Plant for the Moody Bible Institute.

## A Well Designed Central Plant for a Group of Buildings.

The Moody Bible Institute, of Chicago, is just celebrating twenty-five years of continuous and sucessful work in training men and women of all denominations for missionary, evangelical and ministerial work. From modest beginnings this Institute has extended its influence until now thousands of its former students are engaged in active religious work in all parts of the world. Coincident with the extension of its influence and activities there has been a necessary increase in the physical equipment of the institution. Additional buildings have been acquired, enlarged and rebuilt, until now the Moody Bible Institute occupies most of the block along La Salle Avenue between Chicago Avenue and Chestnut Street.

VIEW IN BOILER ROOM.

MAIN SWITCHBOARD.

Comprised in the present group of buildings is the well known Moody Church at the corner of Chicago and La Salle Avenues; the main building and men's department containing the offices, library, lecture and dining rooms, as well as part of the men's dormitories; the women's department and dormitories scattered through several buildings; and a building for music studios, meeting rooms, etc. A good idea of the arrangement of all this group of buildings may be obtained from the accompanying plat.

In March, 1909, the Moody Bible Institute decided on plans for the erection of several new buildings, as the buildings then is use had become inadequate to the greatly increased number of students. As a central heating plant was contemplated, it was suggested to combine with it the generation of current for the lighting and power requirements of all the buildings. After considerable investigation the economy of this plan secured its adoption. It was required that the central plant be so built as to be capable of supplying all the heat, light and power needs of all the existing and contemplated buildings of the Institute.

As the main building was the most centrally located in relation to the future buildings, it was decided to take out its old heating plant and remodel the basement in order to provide space for the new boilers and engines. This building is 100 feet deep and 120 feet wide and five stories high; it has a court thirty feet square in the center. The west half of the basement was excavated as much as the building footings would allow, which was from three to four feet below the old basement floor line and, as that alone did not give sufficient headroom for the boilers, the floor above the latter was raised another three feet. On the main floor is the office and library, while the upper floors serve for sleeping rooms. It was therefore required that the plant should be absolutely free from vibration and that it should not interfere with the main purpose of the building.

The new floor above the boilers was made of terra-cotta tile and concrete in order to make it fireproof. The boiler and engine-room floors are of concrete. The basement walls are of stone and brick, the inside partition walls are of plastered tile. The engine and boiler rooms are both of the same size, 42 feet wide by 48 feet long. The ceiling of the engine room is eleven feet high and the boiler room is fifteen feet in the clear. There are windows on three sides of the space so there is plenty of air and light.

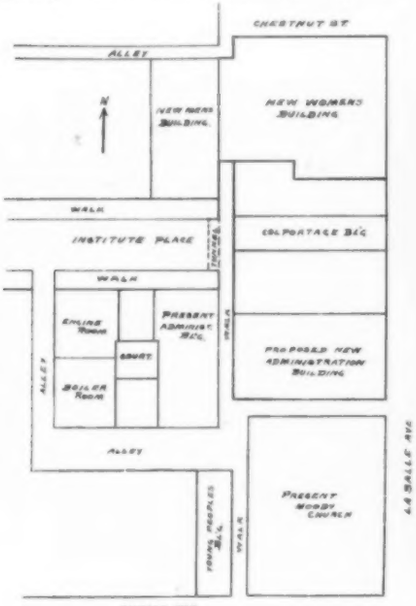
The boiler equipment consists of three 72 inch by 18 foot Kewanee return tubular boilers built to operate on 150 pounds of steam if desired. They are built of one-half-inch steel plate with butt double-strap seams and quadruple-riveted shells. There are seventy four-inch tubes in each boiler. These boilers are provided with standard water columns, and gauge glasses, pop valves, low-water alarm devices, and ten-inch illuminated dial steam gauges. The boilers are set in the standard brick setting, with the bottom of shell 5.5 feet from the floor line.

The furnace equipment consists of three Burke extension furnaces having approximately thirty square feet of grate each. The smoke flues and stack were designed to accommodate a fourth boiler for future demands; the

stack is fifty inches inside diameter and 125 feet high, built of steel and lined with two-inch Vitrobestos.

As the boiler-room floor is about ten feet below the alley level, this afforded an opportunity to build a large coal vault underneath the alley so the coal, which is all delivered by team, can be weighed on the wagon scale and then dumped down through manholes into the storage bin below. A motor-driven ash hoist is also located in this coal vault.

Water is supplied to the boilers by means of two 7.5 by 4.5 by 10-inch Deane horizontal duplex feed pumps; these pumps are bronze-fitted throughout and take their suction from the feed-water heater. The open feed-water heater is of 700-horsepower capacity and was furnished by W. Baragwanath & Son, as well as the closed heater, which furnishes the hot-water supply for the various buildings. The open heater delivers the feed water to the feed pumps at 200 to 210 degrees Fahrenheit. Both the heaters take the exhaust steam from the exhaust main by absorption, as the steam does not pass through the heater. The feed-water heater is supplied with water from the city main, the heating returns, and the high-pressure traps on the main steam-header drain and traps on the separators.




PLAT OF BUILDINGS.

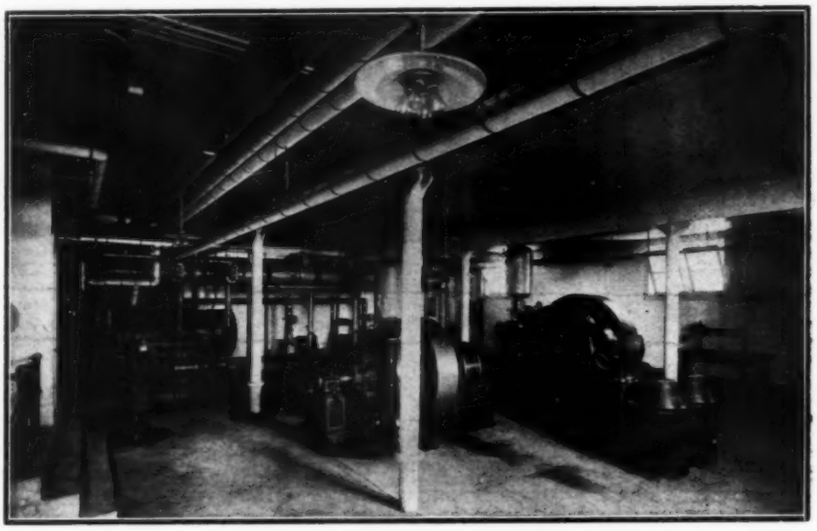
The main steam header is twelve inches in diameter and was made as short as possible. The main supply header which runs over the boilers is of ten-inch diameter. The boilers are connected to this by means of five-inch bends; each of these boiler connections has been provided with a gate valve at header end and one of Erwood's reversible non-return valves. The engine leads are taken from the main header to large receiver separators installed directly on the throttle valves of the engines. A three-inch connection is taken from the main header and run over the pumps, from which each pump takes its steam supply independently.

The exhaust pipe from the engines is run in a trench in the floor, which is provided with an iron cover. This exhaust is run over to the large oil separator and from there to the heaters and to the roof. A twelve-inch connection is taken off between the heaters for steam supply to the heating systems of the various buildings.

From the end of the main high-pressure header a live-steam connection is made through a pressure-reducing valve, which reduces the steam pressure from 125 pounds on the header to 60 pounds. From here a sixty-pound steam line is run to the church building to supply heat to the blast heating coils and to run the old fan engine, as the main part of the church is heated in this manner. There is a second pressure-reducing valve in the engine room which reduces the pressure of the live steam from sixty pounds to zero for an additional supply of steam to the vacuum heating of the new buildings. Several of the old buildings are heated by the single-pipe direct system; these are supplied now from the main heating supply lines. Thus there are three different kinds of heating all working very satisfactorily from one supply main and on a vacuum return line.

Each building has a dip meter, made by the American District Steam Company, connected into its return line to weigh the condensation coming back, for which a charge is made by the central plant. In the case of the small single-pipe systems a trap was installed between the meter and the radiators to insure that only water came back through the meter. The large meters are provided with double-pipe condensing coils to cool the returns so that only water is passed through the meters.

There have been installed two 8 by 12 by 12-inch single-cylinder vacuum pumps, either one of which will take



GENERAL VIEW OF ENGINE ROOM.

care of the entire heating system. All piping for the engines and auxiliaries is confined to the engine room, all returns from the vacuum heating systems in the various buildings are brought back to the vacuum pumps in the engine room and discharged back into the feed-water heater. The entire power piping was done by W. A. Pope, of Chicago. Most of the valves, pipe and fittings were furnished by the Crane Company.

There is one 6 and 10 by 8.5 by 12-inch hortizontal duplex tandem-compound house pump, which takes its supply from the city main through a large filter and discharges direct

to the two roof tanks. One of these is a 10,000-gallon tank on the roof of the building where the plant is located and one a 5,000-gallon tank on the roof of the new women's building, the two tanks being cross-connected in the basement. A motor-driven centrifugal pump of 125 gallons per minute capacity has been installed in the new building as an auxiliary house pump to be used in case the steam-driven house pump is out of service.

In the plant there was also installed an eighty-four-inch Jewell vertical pressure filter, which purifies the city water before it enters the buildings and the boilers. As the basement drains are all below the sewer level, a small motor-driven bilge pump was installed in the plant.

All the light and power for the various buildings is furnished by the central power plant, in which there were installed two engine-driven generating units. The large engine is a Ball 17 by 20-inch horizontal, single-cylinder, side crank, corliss-valve engine, direct-connected to a Westinghouse 150-kilowatt, 250-volt, direct-current generator, running at 200 revolutions per minute. The smaller engine is a 14 by 14-inch similar engine direct-connected to a Westinghouse 75-kilowatt 250-volt generator, running at 275 revolutions per minute.

The generators are of the three-wire type and provided with balancing coils of ample capacity to carry an unbalance of twenty-five percent of full-load current continuously, and full load on one side of the system with no load on the other without injury for ten minutes. Current is delivered to the switchboard by means of cables run in Galvaduct conduit under the floor; from here it is distributed to the various buildings by cables run in conduit on the basement ceilings. Two and three-wire circuits are run for power and light respectively.

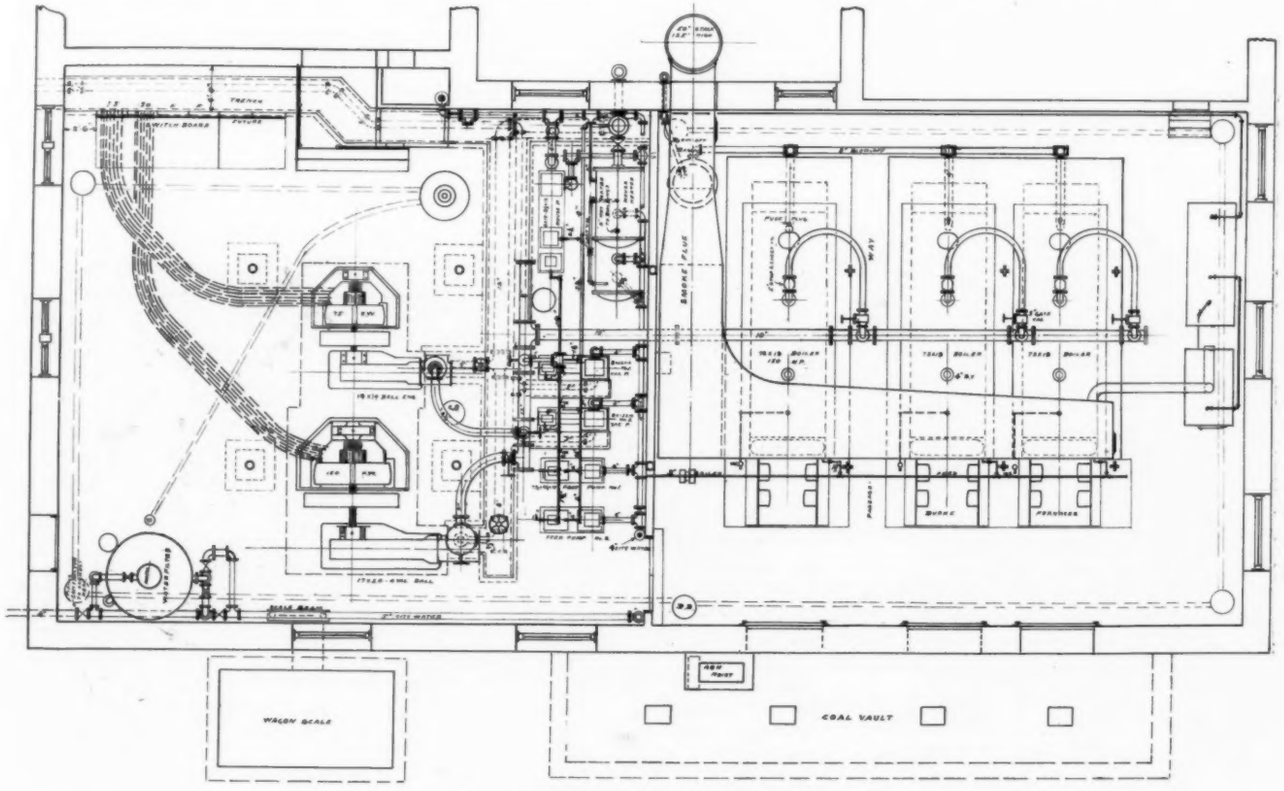
The switchboard consists of four panels, two for the machines and two for the feeders, with a voltmeter on a bracket at the side. The board is made of two-inch oiled slate, bolted to a substantial angle-iron frame. All connections on the rear are made of copper bars of large carrying capacity. The switchboard and all of the wiring system was installed by Kohler Brothers, of Chicago.

In each of the new buildings there is installed an Otis electric passenger elevator of 2,500 pounds capacity, run by a magnet-control drum machine located in the basement.

Mounted on the wall of the boiler room is a draught gauge, $CO_2$ recorder and on the flue above is a high-reading pyrometer. Above the engineer's desk is a set of steam, vacuum and water gauges. Readings are taken regularly from the hot-water meter in the boiler-feed line, the return meters, and watt-hour meters, from which monthly records are kept of the station output and operating costs.

In the basement of the new building just being built there will be a large dining room seating 600 people and in the rear a large kitchen. In a small room off this kitchen there is a three-ton motor-driven refrigerating machine which is used to cool the ice boxes and the drinking water which is circulated through the buildings by means of a separate pipe from the other hot and cold water.

The steam and electrical work for this complete plant was designed by and erected under the supervision of W. A. Bloneck & Company, consulting engineers, Chicago; H. A. Seward was the engineer in charge of the work. H. B. Wheelock was the architect for all the new buildings.




PLAN OF ENGINE AND BOILER ROOM.

## THE PUBLIC AND THE PUBLIC-SERVICE CORPORATION.

DISCUSSED AT MEETING OF WESTERN SOCIETY OF ENGINEERS.

At the meeting of the Western Society of Engineers held in Chicago Wednesday evening, February 1, 1911, in the rooms of the Society, a paper entitled "The Public and the Public-Service Corporations," by John M. Ewen and A. Bement, was presented by the latter. President O. P. Chamberlain presided.

THE PUBLIC AND PUBLIC SERVICE CORPORATIONS.

In the past it has been the disposition of the average citizen to feel that competition in public utilities is desirable. It is not strange that this is so, as he has found by experience with those purchases which contribute so largely to household and business operation, that competition is beneficial to him, and it is usually difficult to realize that conditions controlling the relation between buyer and seller are quite different when public utilities are concerned. Experience has demonstrated that competition between public utility corporations has, in most instances, resulted in an increased cost of service to the consumer. This is natural, because if two gas or water companies are in competition, it necessarily follows that they will each have pipes for the supply of their commodity in every street of the territory served. Thus, we have two sets of equipment supplying customers on the same street, when one would have answered. While temporarily a customer may, under some circumstances, reap benefit from such competition, eventually he must pay for the duplication of service, because rates eventually cover the cost of duplication. But competition is an economic error that should never be permitted, because there are other methods for the protection of the public which may readily be made available. If it is conceded that competition is no longer desirable, it necessarily means that the public service corporation shall be granted exclusive rights, or, in other words, be given what is generally understood as a monopoly. This being true, it is necessary that the authority under which the corporation may operate shall properly define its duties and privileges, also that problems affecting the detail relations of one with the other shall be dealt with adequately, as they arise. If a monopoly be granted a corporation, the effects incident to competition and the uncertainty of the future are eliminated. This being true, it should follow that a corporation would not feel the necessity of accumulating profits, which might be necessary under other conditions. This would tend toward service being sold at cost, which, of course, includes fixed charges, sinking fund, insurance, taxes, interest, dividends, etc., having in mind that dividends and interest are just as much cost as is labor or fuel. But there is a danger in service being sold for actual cost, because this would remove the great incentive for progress—that of making money—or, in other words, realizing a profit on the business conducted, which, within certain limits, is desirable from the standpoint of the good of the public. As a solution of the problem, the establishment of suitable commissions as a means for handling these problems is suggested. A suitable commission of engineers and business men, or of engineers who are also business men, or a commission of business men who are also engineers, possessing proper authority and devoting a requisite amount of time to tne problem, should insure an adequate solution, which would enable our legislators to act with a full understanding of the requirements of the situation. It is not proposed that a single commission be burdened with the problems of all public utilities, but that one commission be established for each character of service, because the questions which present themselves, as well as those which will necessarily arise, will require the attention of a board of specialists thoroughly familiar with the service. Aside from the matter of determining and arranging for the more important features of franchise requirements, many problems of detail affecting the comfort and welfare of the public, as well as the success of the service, present themselves.

A discussion of this paper prepared by Charles V. Weston, president, South Side Elevated Railroad, was read by the secretary of the Society. Mr. Weston agrees that the establishment of a public service commission is inevitable, but he urged that a distinction be made between government administration and government supervision.

S. J. Larned, of the Chicago Telephone Company, said that present conditions seem to indicate that the question is not whether or not there should be regulation, but by whom it should be exercised. He indorsed the idea of establishing a public service commission, and said that such a commission should be composed of experts. Regulation intrusted to the Legislature resolves itself into administration of public utility companies. Governing bodies do not heed decisions rendered by commissions in similar cases, but attempt to enact new laws regardless of the conditions or results.

Mr. Larned then read a written discussion prepared by A. S. Hibbard, general manager, Chicago Telephone Company. Mr. Hibbard stated that reasonable regulation can only be given by a commission composed of experts who have studied the affairs of public utility companies. Before the affairs of a public service company can be fairly regulated the origin, growth, development and organization of that company should be thoroughly studied. Mr. Hibbard expressed a preference for a state rather than a local commission.

J. G. Wray, chief engineer, Chicago Telephone Company, spoke of the condition of the streets of Chicago as regards the underground installations of conduit, pipes, etc. He advocated that should a commission be formed its power should include the regulation of underground installations.

P. Junkersfeld, of the Commonwealth Edison Company, spoke of the financial aspect of regulation. He said drastic action by any body having jurisdiction over public utility companies would result in stockholders demanding a higher rate of return on money invested which would indirectly affect the public.

D. W. Roper, of the Commonwealth Edison Company, spoke of the chaotic condition of the underground work, particularly in the metropolitan district in Chicago. The city sewers are on the lowest level, which is only about eight feet below the street level. It is necessary, therefore, for all electrical conduits, water pipes, etc., to be installed above the level of the sewer mains. Regulation of these conditions was advocated by Mr. Roper as a partial relief.

City Engineer John Ericson indorsed the points brought out by Mr. Roper and urged that some agreement be made whereby more enlightened conditions could obtain.

C. D. Hill, of the city sewer department, spoke in favor of a local commission to have supervision over Chicago affairs. He also spoke at some length regarding the condition of the underground conditions in Chicago and said that co-operation between the public utility companies and the City would tend to relieve future congestion.

John W. Mabbs, chief engineer, Board of Trade, spoke of the personnel of a commission. He said it should be composed of men of the highest character. This commission should be empowered to rule over all of the public utility companies, all of which should be owned by the people.

G. L. Clausen said that he believed the Western Society of Engineers was overstepping its scopes, as a body of engineers, in advocating or condemning government action relative to the establishing or failure to establish public service commissions. He said that engineers should collect engineering data relative to commissions and present it through the proper channels.

J. R. Cravath held that the duty of the engineer was more than the collection of facts and figures. He said engineers should use whatever influence they have in the effort to obtain favorable legislation.

In closing the discussion Mr. Bement said that it was adjustment rather than regulation that was desired by the pub-

lic. He held that the members of a public service commission should be men of the highest character, removed from politics, appointed permanently, and should have jurisdiction over the entire state.

### Leasing of Water-Power Sites.

A bill, known as H. R. 32,399, to authorize the leasing of public lands may be leased for periods not exceeding fifty years. Leases are not to embrace more land than is necessary for the development and utilization of power, and are to be irrevocable except during the term except for breach of conditions or of the regulations established which are not inconsistent with the lease, or for charging higher rates for power than may be established by the State where the land is located or the power sold.

Moneys received on leases of lands are to be used in the same manner as other receipts from the same class of lands.

Lessees are to be given the preference on renewals of leases for a second period of not over fifty years, and shall receive compensation if the works are taken over by a new lessee or by the Government. Leases may be transferred only with the consent of the executive official having jurisdiction. No lease shall be granted to or held by any trust.

for the development of hydroelectric power, was introduced in the House of Representatives by Mr. Parsons on February 2, and was referred to the Committee on Public Lands. The bill provides that, subject to regulations to be made by the Secretaries of Agriculture, Interior, Commerce and Labor, and War, public lands of the United States and reservations, parks, etc. (when not incompatible with the purpose for which they were established)

### Estimate of the Value of Electrical and Auxiliary Manufactures in the United States.

Attention has been directed to the fact that a number of copies of the issue of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for January 7, 1911, were printed with the omission of a number of important items in the tabulation giving the estimate of value of the electrical and auxiliary manufactures in the United States. This was due to a physical accident over which we had no control, and in order that this information may be complete we are here reproducing this table for the benefit of our readers.

ESTIMATE OF THE VALUE OF ELECTRICAL AND AUXILIARY MANUFACTURES IN THE UNITED STATES.

| ARTICLES. | For the Year— 1906 | 1907 | 1908 | 1909 | 1910 |
|---|---|---|---|---|---|
| Arc lamps and appurtenances | $ 3,225,000 | $ 3,150,000 | $ 2,000,000 | $ 2,500,000 | $ 2,750,000 |
| Auxiliary steam plant for electrical installations, such as pumps, condensers, separators, feed-water heaters, injectors, piping, etc | 3,275,000 | 3,100,000 | 2,000,000 | 3,000,000 | 3,350,000 |
| Bells, buzzers, push-buttons, call-boxes, annunciators | 1,250,000 | 1,300,000 | 1,300,000 | 1,500,000 | 2,000,000 |
| Belting used in electrical plants | 450,000 | 425,000 | 200,000 | 200,000 | 200,000 |
| Boilers for electrical plants (water-tube) | 7,500,000 | 6,000,000 | 4,000,000 | 5,000,000 | 5,500,000 |
| Boilers for electrical plants (other than water-tube) | 2,750,000 | 2,500,000 | 1,500,000 | 1,750,000 | 2,500,000 |
| Cables, underground, aerial and submarine | 22,000,000 | 18,000,000 | 10,000,000 | 11,000,000 | 12,500,000 |
| Carbons for lamps, batteries, brushes or other electrical purposes | 3,500,000 | 3,500,000 | 2,250,000 | 4,000,000 | 4,500,000 |
| Cars and trucks for electric railways | 11,750,000 | 8,650,000 | 6,900,000 | 7,500,000 | 5,000,000 |
| Castings, copper, and other metals, used by electrical manufacturers | ..... | ..... | 300,000 | 500,000 | 600,000 |
| Circuit-breakers | 1,700,000 | 1,675,000 | 920,000 | 1,200,000 | 1,350,000 |
| Conduits (underground) and similar material | 2,900,000 | 1,700,000 | 500,000 | 700,000 | 850,000 |
| Conveyors, coal and ash, used in electrical plants | 900,000 | 775,000 | 400,000 | 425,000 | 500,000 |
| Cranes and hoists, electrically operated | 6,750,000 | 5,850,000 | 3,500,000 | 4,500,000 | 6,000,000 |
| Dynamos and motors, including parts of machines, boosters, balancers, rotary converters, motor-generators, etc., and all motor applications, such as in automobiles, not specifically enumerated in this list | 74,000,000 | 62,500,000 | 50,000,000 | 70,000,000 | 75,000,000 |
| Electroplating and other electrolytic apparatus not elsewhere specified | 1,000,000 | 1,000,000 | 1,000,000 | 1,100,000 | 1,000,000 |
| Electrostatic machines, induction coils, medical sets, etc | 550,000 | 500,000 | 500,000 | 600,000 | 750,000 |
| Elevators, electric (mechanism only) | 5,500,000 | 4,675,000 | 1,600,000 | 2,000,000 | 2,600,000 |
| Engines, gas, gasoline or oil, used to drive electrical machinery | 3,500,000 | 4,300,000 | 6,000,000 | 9,000,000 | 9,000,000 |
| Engines, steam (reciprocating), used to drive electrical machinery | 13,500,000 | 12,000,000 | 9,000,000 | 12,000,000 | 12,000,000 |
| Fans, electrically operated and direct-connected | 1,575,000 | 1,850,000 | 1,100,000 | 1,500,000 | 2,000,000 |
| Fire-alarm apparatus, also burglar alarms, crossing indicators, etc | 1,850,000 | 1,850,000 | 900,000 | 1,000,000 | 800,000 |
| Fixtures for electric lighting | 5,300,000 | 7,500,000 | 8,000,000 | 10,000,000 | 11,000,000 |
| Fuses | 900,000 | 1,200,000 | 750,000 | 1,000,000 | 1,150,000 |
| Glassware, electrical | 900,000 | 1,450,000 | 2,000,000 | 2,500,000 | 3,000,000 |
| Heating and cooking apparatus, electrical | 850,000 | 1,100,000 | 1,000,000 | 1,500,000 | 2,000,000 |
| Incandescent lamps (carbon or metallic filaments) | 8,600,000 | 10,000,000 | 11,000,000 | 14,000,000 | 17,500,000 |
| Instruments for measurement and meters of all kinds; also ground detectors, scientific and laboratory apparatus, photometers, Leyden jars, X-ray outfits, etc | 5,000,000 | 5,000,000 | 2,000,000 | 2,250,000 | 2,400,000 |
| Insulating material, fiber, tape, etc | 2,300,000 | 2,850,000 | 1,700,000 | 2,500,000 | 2,700,000 |
| Insulators (glass and porcelain) | 2,100,000 | 2,000,000 | 1,350,000 | 2,300,000 | 2,560,000 |
| Interior wiring supplies, as tubing, interior conduit, molding, junction boxes, rosettes, outlet boxes, etc | 3,000,000 | 3,500,000 | 2,220,000 | 3,000,000 | 2,500,000 |
| Lightning arresters | 525,000 | 500,000 | 275,000 | 400,000 | 500,000 |
| Mercury-vapor lamps | 350,000 | 450,000 | 300,000 | 500,000 | 700,000 |
| Nernst lamps | 950,000 | 950,000 | 1,000,000 | 1,000,000 | 750,000 |
| Poles and wire towers, cross-arms, brackets and pins | 7,500,000 | 5,125,000 | 3,500,000 | 4,000,000 | 5,000,000 |
| Primary batteries | 1,825,000 | 1,800,000 | 1,000,000 | 2,000,000 | 2,500,000 |
| Railway supplies, electric, such as trolleys and other contact devices, strain insulators, cross-overs, rail-bonds, etc | 3,000,000 | 4,000,000 | 2,200,000 | 3,000,000 | 3,250,000 |
| Rheostats, car controllers, motor starters, etc | 4,600,000 | 4,750,000 | 2,600,000 | 4,700,000 | 5,000,000 |
| Shafting, pulleys, clutches, etc., used in electrical generating plants | 800,000 | 725,000 | 400,000 | 500,000 | 500,000 |
| Signs, electric | ..... | ..... | 1,000,000 | 1,250,000 | 1,500,000 |
| Sockets, switches, cutouts | 5,500,000 | 5,500,000 | 4,000,000 | 5,000,000 | 6,000,000 |
| Steam turbines used to drive electrical machinery | 8,000,000 | 8,000,000 | 7,000,000 | 12,000,000 | 14,000,000 |
| Storage batteries, including those used in automobiles | 6,950,000 | 6,200,000 | 5,500,000 | 6,600,000 | 6,750,000 |
| Telegraph instruments and apparatus | 375,000 | 475,000 | 400,000 | 600,000 | 500,000 |
| Telephones, telephone switchboards and distinctively telephonic apparatus | 28,500,000 | 21,000,000 | 15,000,000 | 15,000,000 | 20,000,000 |
| Third rail for electric railways | 950,000 | 750,000 | ..... | 1,000,000 | 1,000,000 |
| Transformers, stationary | 6,850,000 | 5,500,000 | 3,025,000 | 4,000,000 | 4,500,000 |
| Waterwheels, used to drive electrical machinery | 2,750,000 | 3,100,000 | 3,000,000 | 4,000,000 | 3,500,000 |
| Welding apparatus, electric | 110,000 | 120,000 | ..... | 150,000 | 200,000 |
| Wire, bare | 33,000,000 | 27,000,000 | 18,000,000 | 22,000,000 | 24,000,000 |
| Wire, rubber-covered | 14,000,000 | 16,500,000 | 11,000,000 | 12,000,000 | 15,000,000 |
| Wire, weatherproof | 15,000,000 | 15,000,000 | 9,000,000 | 10,000,000 | 12,000,000 |
| Wire, all other electrical | 4,625,000 | 4,150,000 | 4,000,000 | 5,000,000 | 5,000,000 |
| Wireless apparatus | 475,000 | 425,000 | 500,000 | 500,000 | 350,000 |
| Miscellaneous, including switchboard frames and panels, signs and flashers, automatic stokers for electrical plants, wire guards, electrical tools and toys, projectors, solenoids, igniters for gas engines, waterwheel governors for hydroelectric plants, voltage regulators, electric drills, commutator compounds, lamp adjusters, shade holders, etc | 6,000,000 | 4,000,000 | ..... | 10,000,000 | 10,000,000 |
| Total | $351,010,000 | $315,920,000 | $228,590,000 | $304,225,000 | $338,060,000 |

### How to Introduce Electrical Machinery Into China.

United States Consul General George E. Anderson, of Hongkong, writes that while the imports of electrical machinery and appliances into China at present do not exceed a million dollars per annum, there is almost no limit to the possibilities of such imports were the matter of supplying light and power to the large cities open to forengn trade and influences properly exploited. In these cities there is a demand for electric serice, but the lack of capital among those who appreciate the value of the new force in commerce and industries and the general ignorance which prevails as to the manner of using the same retard its building up by local financiers, and foreign capital does not seem to be attracted where it would not only have to build the light and power plants but where it would have to instruct the consumers in its uses to a certain degree. But these things overcome, as they can be overcome, there is no limit to the business which is possible—business which is really waiting for capitalists to take up.

The matter of having special agents in China to represent American electrical, railway, factory and other machinery is of vital importance, if contracts are to be secured, for the following reason:

There are in China few Chinese engineers who are trained by experience or otherwise to lay out any sort of industrial plant, technically, from beginning to end; who can, for example, draw up specifications for an electric light and power plant, indicating the nature and capacity of dynamos and engines, the technical requirements of switchboards, converters, and all the several portions of a complete and properly co-ordinated electric plant. There are few, if any, Chinese engineers capable of economically and safely planning for traction power of railways, for grades and curves, and locomotives to overcome them with loads economically calculated. All these things come within the work generally given to foreign engineers in connection with Chinese as well as foreign companies.

The result is that specifications drawn by the foreign engineers call for machinery or appliances favored more or less by such engineers, and the sale of the goods so favored, even where there is open competition by bids or otherwise, is practically settled when the specifications are drawn. This is true not only of China but it is true of most portions of South America and many other parts of the world. The absolute necessity of having American engineers on the ground as representatives of American manufacturers, if the latter are to have their share of the trade, is apparent therefore.

Japan possesses an unusually large number of available streams suitable for hydroelectric power enterprises, and the assembling of its operatives in factories and mills (instead of confining their efforts mostly to home industries) will be felt in the output of their organized productive capacity far outside the Empire.

The demand for electrical machinery in Japan is increasing, and plants for its promotion are being built within the Empire by Japanese and foreign capital combined.

The Government has taken into consideration the fact that Japan's coal consumption has approximately doubled during the past ten years, largely from demands for power used in manufacturing enterprises, and it is assumed that this steadily increasing demand for power plants may be expected to increase greatly the cost of coal, to meet which the authorities look to the anticipated rapid development of cheap water-power facilities, and they estimate that from a possible 1,000 localities in Japan suitable for such purposes approximately 1,000,000 horsepower may be utilized.

### Electro-osmotic Cells.

Botho Schwerin has recently taken out a French patent on a production of electric currents in which he proposes to generate electricity by forcing water or electrolytes through a porous wall. The suggestion is based upon an observation first made by Quincke at Heidelburg. Quincke tried water, to which he added some chemicals; Schwerin proceeds on the same lines. His filter-cell is built up of several superposed sheets and layers, and it is bolted to the lower face of a flat ring of iron which is covered with rubber; the patent specification does not illustrate the cell. The layers consist of finely-perforated brass, metallic gauze, silk, very fine metallic gauze (the one electrode), the filtering material, and fine gauze (the other electrode). The materials should be in a very fine state of subdivision or in the colloidal state. They are distinguished as electro-negative when the electric current flows in the direction of the aqueous current, and as electro-positive when it flows in the opposite direction. To the former class belong silica, baked clay, sulphur, lazulite blue, non-conducting carbon; to the latter anthracite. The addition of electrolites to the water increases the conductivity, and may strengthen or weaken the current; it depends upon the filtering material. For electro-negative materials basic electrolytes (ammonia) are recommended, for electro-positive materials acid electrolytes (acetic acid). Quincke tried the latter under unsuitable conditions, and his currents were therefore very feeble. In practice neither of the two electrolytes mentioned may be desirable, although the liquid is to be kept in continuous circulation; but Schwerin does not speak of other electrolytes. One of the essential factors is the pressure. Since the potential increases with the pressure, the energy developed increases with the square of the pressure. Experimenting with a filter-cell two square decimetres in surface, with a layer 6.5 millimeters in thickness, of quartz as filtering material, he obtained four volts, 0.01 ampere, 0.04 watt at a pressure of ten atmospheres, and these values increased to 32 volts, 0.08 ampere, 2.56 watts, at 80 atmospheres, the resistance being 400 ohms.—*Engineering.*

### American Supply & Machinery Manufacturers' Association.

The annual meeting of the American Supply & Machinery Manufacturers' Association will be held at Louisville, Kentucky in conjunction with the National Supply & Machinery Dealers' Association and the Southern Supply & Machinery Dealers' Association, on April 3, 4 and 5.

### Receiver for Universal Carbon Company.

The Universal Carbon Company, which filed an involuntary petition of bankruptcy, has passed into the hands of Arthur L. Woodman, recently appointed receiver. Lack of capital is said to be the cause of the corporation's failure.

# Electrical Notes From Great Britain.

By Our British Correspondent.

As usual, the first few weeks of the year have brought many reviews of the course of electrical industry during 1910 and forecasts of the current year. Generally speaking, there appears to be a bright prospect for British engineering trades, including electrical. The Hull Corporation has settled upon a $500,000 scheme for extensions, including a new power station in Sculcoates Lane capable of holding a plant capacity of 16,000 kilowatts, but starting at the beginning of next winter's load with 4,000 kilowatts. It is intended to thus increase the flexibility of the system so as to cope with a rapidly growing demand. A part of the scheme includes the spending of $25,000 on motors for hiring out to power-users. Among other schemes on foot in London is that of Hammersmith Council for the addition of a steam and electric plant, including a 3,000-kilowatt turbo-alternator, condensing plant, boilers and a steel chimney, at a cost of $126,000. Halifax Corporation has ordered a 1,500-kilowatt turbo-generator, condensing plant and two 750-kilowatt rotary converters, costing $40,000. The Leyton Council has been sending a deputation to stations in different parts of the Kingdom inspecting exhaust and mixed-pressure turbines at work, and the outcome is the approval of mixed-pressure type for extension purposes. Greenock Council is to proceed with plant and general station additions ($110,000), in order that it may meet new demands for power, including those of the Admiralty for driving and lighting its torpedo factory, and those of Scott's Shipbuilding Company.

It is reported that a scheme is under consideration for a four-and-one-fourth-mile extension of the Central London tube line from Wood Lane terminus to Ealing Broadway, providing a connection with the Great Western Railway, which will bear the cost of the work. The electrification of the East London Railway, which line has been a problem for years, is once more receiving attention and a survey is now being made so that a report may be submitted.

According to reports, the battle of the systems (alternating vs. direct-current) seems to be what is holding back the great railways of London and the important provincial centers from large suburban-line electrification schemes. Meanwhile, the London & Brighton Company is proceeding with its single-phase extension to the Crystal Palace, which is expected to be completed by the date of the coronation of King George V in June.

An excellent electrical exhibition arranged by the corporation electrical department, with the co-operation of well-known electrical manufacturers, contracting firms and others, has just been brought to a close at Belfast. Here, as at some other exhibitions, what has appealed to the general public most of all has been the electric house, consisting of several rooms, kitchen, scullery, laundry, and the like, in which electricity is at work.

There has been considerable discussion going on among electrical engineers just now concerning heating and cooking apparatus, for in the course of a few weeks papers have been contributed at the Yorkshire, Manchester and Glasgow Sections of the Institution of Electrical Engineers. The speeches, as well as the papers, have shown how real an interest is now being taken in this department.

The Institution of Electrical Engineers (London) has two papers before it on January 26, namely, Modern Long-Distance Transmission of Electrical Energy, by W. W. Taylor, and Extra-High-Pressure Transmission Lines, by R. Borlase Matthews and C. T. Wilkinson. A useful paper on steam condensing plants has been considered by the Manchester Association of Engineers. W. A. Dexter compared the advantages of various types of plants and their adaptability for varying conditions of service, also indicating the most suitable vacuum for steam turbines with varying temperatures of cooling water.

The subject of electro-magnetic transmission for marine propulsion has again been occupying the attention of the Institute of Marine Engineers in London, the paper by Jules Lecoche, and one by W. P. Durtnall on the internal-combustion engine being continued as the basis for discussion. One speaker remarked that the economical aspect was the main one in relation to the proposal to adopt the internal-combustion engine for marine purposes. One difficulty would be in obtaining the requisite speed of the engine to suit the propeller, and the question of propeller design would thus be involved. E. Shackleton said that the oil-engine makers had made a reversible engine because of the demand for reversibility, although in the majority of cases he thought they would have preferred an intermediate electric drive. He did not think ship-owners were at present inclined to the adoption of electrical driving, but personally he considered it the best system for reversing and maneuvering.

Constructional experts acting under orders from the Lords Commissioners of the Admiralty have just made maneuvering, steering and reversing trials of the "Paragon 1st" motor-boat, which is fitted with the Paragon marine steering propeller. The inventors claim that with this propeller the revolution speed is higher per unit of effective thrust, making the weight, cost and space lower, and the efficiency higher than is the case in connection with the slow-speed screw propeller.

Tramway operating authorities in England are just now engaged with two problems, one of which is how to get more out of the public for the service they render, the other being how to resist the demands of their own employees for shorter hours or longer pay. The "Fair fare" system which, it will be remembered, was adopted by a number of companies, and was met with much criticism, accompanied in some districts by determined hostility, has given such a small satisfaction that farthing charges were abandoned on the last day of the old year at Airdrie and Coatbridge, the former system of fares being reverted to. The Glasgow Corporation has just started a new concession to the traveling public—its tramway profits are so large that it need not have recourse to systems for producing larger revenue, but is continually granting new privileges.

Preparations are in progress for a conference to be held at Glasgow at

which municipal corporations from all parts of the United Kingdom will be represented, for the purpose of bringing influence to bear upon the Postmaster-General regarding telephone charges. The object is to make certain that no new rates shall be introduced for existing users until the whole subject of telephonic communication and charges has been exhaustively investigated and reported upon by a special Parliamentary Committee. The fear apparently is that when the National Telephone Company's service is taken over at the end of the present year, some users who now pay comparatively low bills will on the "measured rate" basis pay considerably more for the service they are receiving than they have been in the habit of doing. It is said that any step of this kind would only tend to retard telephonic development here, whereas what is desired is that a policy of large expansion should be adopted. The visit of Dugald Jackson to this country is stated to be for the purpose of advising the Postmaster-General both on the question of the valuation of the system and on future rates to users.

A further step in the direction of regulating the competition between gas and electric-light undertakings, where both are owned and controlled by the same municipal authority, has just been taken at Manchester, where a conference of those responsible for the respective policies of the two departments is being held at the invitation of the Lord Mayor. One ground of complaint whereon the desire for conference rests, is found in the different financial policies which have allowed the profits from the gas undertaking to be put to reduction of city taxes, while the electricity profits have, for the twofold reason of financial soundness and desire for electrical expansion in the interests of industry and of the city generally, been devoted rather to reducing the charges for electricity.

ALBERT H. BRIDGE.

LONDON, January, 1911.

### An Act Affecting Strikes.

A measure is to be introduced in the United States Senate providing that no restraining order or injunction shall be granted to either employer or employees in case of any industrial disagreements, unless property is in danger.

## THE STRETCHING OF A CONDUCTOR BY ITS CURRENT.[1]

BY CARL HERING.

Many books on physics teach about the mechanical forces which exist between neighboring conductors in which currents flow and between such conductors and a magnet, but do not teach about any mechanical forces in the conductor itself produced by its own current, when the conductor is removed from all other circuits or magnets. In the opinion of the writer, the modern student ought to be prepared to deal with such new forces when he meets with them in new problems. In the more usual problems of engineering, such internal forces may no doubt be neglected; but when the currents become very large, as in some electric furnaces, or in short circuits, forces which ordinarily are negligibly small, may become quite formidable, particularly in liquids which will yield to even small forces, hence in molten masses in electric furnaces. One such internal force was recently discovered by the writer and was found to be quite formidable, so that it places a serious limit to the current which can be passed through a conductor under certain conditions.

The purpose of the present article is to give certain reasons which tend to show that a force lengthwise to a conductor ought to be produced by the current flowing through it. The force is an internal one which tends to stretch and lengthen the conductor, and therefore does not move it as a whole like an external force would; external movements can, however, be produced by it just as the internal forces in a stretched rubber band can produce external motions.

The following eight observations or deductions led to the belief that such a stretching force exists:

*a.* By the internal forces producing the now well known "pinch phenomenon" referred to above, the current tends to contract the cross section of the conductor; when the latter is solid, this force cannot manifest itself and was therefore not noticed before; but in a liquid, which readily responds to forces, it becomes very evident, contracting the conductor at its electrically weakest spot, and if strong enough it may even cause actual rupture. When a conductor contracts in cross section under this radial force, the material of the conductor also moves lengthwise to the conductor somewhere near the central axis, and with considerable force.

One is therefore justified in saying that the conductor acts as though it were being stretched lengthwise, thereby piling up the material at the ends of the tank, which cause it to flow back into the hollow or pinched part. It is true that this phenomenon may be completely and perhaps more satisfactorily explained on the assumption of only transverse, radial forces, the horizontal flow being then due merely to the squeezing action of this radial force causing the liquid to flow lengthwise in the same way as it would in a rubber tube filled with water and squeezed by the hand.

*b.* The second observation which led to the belief of the existence of a stretching force is the electric arc. When horizontal it forms an arch (whence its name) as though the arc itself, which is a perfectly flexible conductor, were stretching itself, often to the extent of rupture. This is usually explained as being caused by heated air currents, which no doubt is true in part; but it does so also when the arc is between vertical electrodes. In this respect an arc acts like a compressed rubber rod, which tends to stretch itself, and if it can do so this stretching force tends to bulge it.

*c.* A bent current-carrying conductor flexible at the corner exerts a force tending to straiten the conductor; when strait the repelling force of these two parts tends to stretch the strait wire. This is also shown in the well known experiment of a circular ring of mercury which becomes larger and larger by the action of the current in it; it tends to expand; a tendency to straiten itself would cause such an expansion. Why should we say that this force ceases when the circle has become infinitely large and is therefore a strait conductor? In an induction furnace this expanding force is said to become so great at times that one can see the bottom of the circular crucible, the metal being forced radially up against the inner side of the outer wall, as if by centrifugal force.

*d.* A fourth observation is Ampere's well known trough experiment, in which a bridge conductor floating on

1 Abstract of article in the *Journal of the Franklin Institute.*

two mercury troughs, is moved as though the conductors tried to become longer.

*e.* A fifth deduction is that, as like magnetic lines of force repel each other, and as every current-carrying conductor is encircled by like circular lines of force, these lines must repel each other in the direction of the axis of the conductor, hence produce a stretching force.

*f.* A sixth deduction is based on the result found by the writer nearly nineteen years ago, that the quantity of magnetic flux produced by an ampere in every centimeter of length of conductor is a constant, assuming no iron and no neighboring conductors or magnetism and a filamental conductor. If, therefore, a conductor be stretched to double its length (which is possible if it is a liquid, or by means of a sliding contact), the current remaining constant, there will be produced twice the flux. The magnetic flux will have been increased in direct proportion to the lengthening of the conductor. All experiments with movable circuits and magnets seem to show that that motion will always tend to take place which will increase the magnetic energy of the combination; the mechanical forces will therefore be such as would bring about those motions. As lengthening a conductor increases the magnetic flux, it indicates that there exists a force tending to lengthen it.

Stretching a current-carrying conductor should therefore produce a counter electromotive force, as in a motor; the overcoming of this counter electromotive force by the source of current represents some mechanical work set free, in this case the lengthening of the conductor. Conversely, compressing a current-carrying conductor should generate an electromotive force, hence be a conversion of mechanical into electrical energy, as in a dynamo.

*g.* A U-shaped copper bar placed into two mercury-cup terminals will be forced up out of the cups with considerable force, when the current is strong enough. This might be said to be a direct consequence of Ampere's trough experiment.

*h.* A recent statement by Dr. C. P. Steinmetz says that "mechanical forces are exerted only where the inductance of the circuit changes with the mechanical motion which would be produced by these forces." The lengthening of a conductor increases its inductance, hence if the converse of the above statement is true, the mechanical force of stretching the conductor should be exerted because the induction changes with the lengthening which would be produced by this stretching.

It might be better to explain all such phenomenon by the simple statement that a magnetic line of force always tends to contract, that it tends to repel a neighboring line of force of the same polarity, and to attract one of opposite polarity. A conductor with a current may then be likened to a wire surrounded by stretched rubber bands like umbrella rings, which are also crowded together laterally; their contraction produces that which corresponds to the pinch effect, and their laterel expansion that which corresponds to the lengthening effect. The stretching of a current-carrying conductor then follows as a consequence, if it is true, as it seems to be, that a line of force is rigid with the material of the conductor carrying the current which produces it.

The writer has frequently called attention to the fact that it is wrong to say, as is so often done in text-books, that like currents attract and unlike repel, as it is not the currents *per se* but the material of the conductor which is attracted and repelled, for otherwise Ohm's law would not hold for large conductors and the pinch effect would then not exist; this distinction is sometimes very important.

So it seems equally wrong to say that like lines of force repel and unlike attract, when it seems to be a fact that it is the material in and about which these lines of force are generated, which is moved or affected by those forces. In that case this stretching force is a consequence; so is the pinch phenomenon.

## Water-Power Development in Minnesota.

That there are in Minnesota 553,700 horsepower in its rivers and lakes, of which 113,100 horsepower is developed and 440,600 not yet developed, was one of the facts reported by the State Drainage Commission in an exhaustive report on the water-power resources of Minnesota. In making this report the Commission estimated the horsepower on the low flow of the streams and did not take into consideration the added power given by storage systems, which, it is estimated, raises the number of horsepower available to 750,000.

The report shows that there are 109 power plants in the state operated by the Mississippi River and its tributaries, producing 76,120 horsepower; twenty-four in the Hudson Bay drainage system, developing 15,000 horsepower; and two in the Lake Superior basin, developing 22,000 horsepower. Most of these plants have auxiliary steam power, especially those supplying industrial concerns.

The situations of the largest plants are: Minneapolis, producing 48,000 from its plants; Rainy River, 12,000; Sartell, 5,000; Cannon Falls, 1,500; Grand Rapids, 1,200; Taylor Falls, 26,000.

It is shown that one-half of the water power of the state is to be derived from the Mississippi River.

The following table compiled by the Drainage Commission shows the extent and situation of the developed and undeveloped power in the state:

PRINCIPAL WATER POWERS OF MINNESOTA.

| | Theoretical Horsepower. | Developed Horsepower. | Undeveloped Horsepower. |
|---|---|---|---|
| Mississippi River | 234,000 | 60,300 | 173,700 |
| Minnesota River | 8,300 | 600 | 7,700 |
| Minnesota River tributaries | 9,500 | 2,400 | 7,100 |
| St. Croix River | 28,000 | 4,500 | 23,500 |
| St. Croix River tributaries | 4,900 | 1,200 | 3,700 |
| Other Mississippi River tributaries above Minnesota River. | 26,300 | 2,000 | 24,300 |
| Other Mississippi River tributaries below Minnesota River. | 28,800 | 5,100 | 23,700 |
| Red River (including Ottertail River) | 30,400 | 1,100 | 29,300 |
| Red River tributaries | 28,300 | 1,900 | 26,400 |
| Rainy River, including both American and Canadian power rights | 22,000 | 12,000 | 10,000 |
| Rainy River tributaries | 61,800 | ..... | 61,800 |
| Lake Superior tributaries east of Duluth | 20,700 | ..... | 20,700 |
| Lake Superior tributaries west of Duluth | 50,700 | 22,000 | 28,700 |
| Totals | 553,700 | 113,100 | 440,600 |

The most important smaller streams mentioned, with their potentiality, are as follows: Root River, 13,000 horsepower; Red Lake, 10,100; Crow Wing, 7,600; Zumbro, 7,600; Crow, 3,400; Rum, 3,400; Minnesota, 8,300; Kawishiwi, 6,100; Wild Rice, 4,100; Kettle, 3,400; Buffalo, 3,800; Vermillion, 3,500; Cannon, 3,200; Little Fork, 3,100.

## SOME GEOMETRICAL ASPECTS OF THE THREE-CHARGE-RATE SYSTEM.

BY HUGO E. EISENMENGER.[1]

### INTRODUCTION.

It is a fact acknowledged long ago that the system of charging the consumer of electric current entirely according to his kilowatt-hour consumption is an illogical one, as it takes into consideration only one out of three factors which bear upon the cost of electricity.

As was pointed out first by Hopkinson in the early nineties of the last century, the cost of producing electricity is determined very largely by fixed charges which have nothing to do with the actual kilowatt-hour consumption, but are created by the necessity of having a certain part of the capacity of the plant set aside and kept ready to serve the customer. The capital invested therein will call for interest and the machinery will become obsolete after a certain number of years just the same, whether a customer uses his proportion of the plant but once a year during peak load or for several hours every day. Depreciation and repair of power plant and lines also depend very largely upon the size of the plant and not so much on the actual output produced, etc. Certain expenses, the so-called fixed charges are, therefore, created by the "readiness to serve" and are a function of the customer's maximum demand and not of his kilowatt-hour consumption.[2]

Under the assumption that the customer's maximum demand is proportional to his connected load, the fixed charges may be based on the customer's connected load, which, though less correct, does away with the necessity of having maximum demand meters.

Credit is due to H. L. Doherty for having shown that the fixed charges are not directly proportional to the customer's maximum demand, but that there is a certain part independent of the latter which is the same for every customer. The connecting lines from the main lines on the street to the customer's house, which sometimes have a considerable length, must be kept in repair, and the poles of the connecting lines renewed. The initial costs of these lines call for a certain amount each year to be set aside for interest and depreciation and these amounts are nearly independent of the energy consumption or the size of the customer's installation. The cost of meter reading, billing, and other office work also is the same for a small as for a large customer, and as will be shown, these "customer expenses" are not at all negligible.

This is the basis of the "Three-Charge System." The amount the customer has to pay is composed of:

(1) A constant. (The customer charge.)

(2) An amount proportional to his maximum demand, or the capacity of his installation. (Demand or capacity charge.)

(3) An amount proportional to the energy consumed. (Output charge or kilowatt-hour charge.)

These three charges will be a certain percentage above the respective cost, for instance the "customer charge" will be the "customer expenses" plus a margin for profit, etc. The customer, demand and output expenses will be called hereafter the "*classified expenses.*"

If it is considered that the part of expenses proportional to the output in different central stations varies somewhere between 5 and 40 per cent, and seldom reaches 50 per cent of the total expenses, it will readily be seen how illogical and unjust any system of rates is which is based only on the meter readings, considering the fixed charges only by averaging them up according to kilowatt-hours consumed.

The various systems of meter charges which give lower rates for large customers or long-hour customers by granting discounts, or by working on a sliding scale with special power rates, etc., prove that the necessity of adjusting the cost of current in some way to the fixed charges is universally felt among central-station men and it will be shown later how crude the methods are, which try to take care of the fixed charges by such indirect methods as sliding scales, discounts, special contracts, etc.

The pure meter rates have been working, however, more or less satisfactorily so far in a great number of central stations, since, by averaging up the total cost of lighting among the customers, according to the energy consumed, the price of the latter has been fixed empirically in such a way that the total income derived from the customers covers the total expenses including a margin for the profit. The appearance of the highly economical metal filament lamp, however, is changing the conditions in a very decided way, especially with small customers. The kilowatt-hour charges have been fixed so high as to cover not only that part of the expenses really proportional to the kilowatt-hours consumed, but also the demand expenses and the customer expenses under the average conditions prevailing. If the customer changes over to metallic-filament lamps, his kilowatt-hour consumption generally will decrease and with it in the same measure the amount of his bill, whereas the expenses he causes do not decrease in the same percentage. His customer-expenses will remain entirely unchanged. Even the demand expenses he causes may be at first constant, or only slightly reduced (although his kilowatt demand decreases) if a large number of customers change within a short time to economical lamps, thus making the existing plant too large for the reduced total load. Only after the natural growth has brought the plant up to full load again will the demand expenses of the customer be brought down in proportion with his decreased maximum demand.[3]

The effect will be that certain classes of customers, by using metallic-filament lamps, will have their bills much more decreased than the expenses they cause. This applies, according to the

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1 The author feels it his agreeable duty to express his special indebtedness to Mr. S. E. Doane for some very valuable suggestions for ideas expressed in this article.

2 It should be understood that this article can cover only those cases where the entire outlay may be classified as expenses of operation or production. In cases where a plant has been built larger than the present needs, to supply prospective demands, the expenditures should not all be charged against the cost of operation or production but a portion of these expenditures should be charged against the optimism of the promoter and should be met by the allowance of an increased profit as an entirely warranted procedure on the part of the management. If charged against the costs it will make the costs enormously high and make it impossible to secure the highest economy in management, whereas, if costs are figured on the two-bases plan, that portion of the outlay rendered necessary by the provision for anticipated energy would be properly charged against the profits, the operating conditions can be better controlled and the public-service corporation be allowed to establish a margin for future expansion to the mutual benefit of the service, customers and the central stations.

It is obvious that this policy, summed up from various commissions as in the London sliding scale applied to the gas rates in Boston with analyzed dividend paid, rather than cost of production, would have the effect of promoting the highest efficiency production which may show a considerably larger profit on the basis of the cost of production than upon the investment and which would make such greater profit proper and just.

3 S. E. Doane, "High-Efficiency Lamps, their Effect on the Cost of Light to the Central Station," read before the National Electric Light Association at its thirty-third convention at St. Louis. May, 1910. (*The Illuminating Engineer*, September, 1910.)

preceding, to those classes whose expenses consist largely of customer or demand expenses or both, that is to small consumers. This may go so far that, as some central-station men contend, some small residential customers are carried at a loss, under the changed conditions, if charged according to their meter readings only.

The metallic-filament lamp, owing to its capacity for cutting down the customer's bill, has found its way to the customer, and its use is bound to spread more and more rapidly. In whatever way a revision of rates to meet the situation will be designed, it will have to increase the average cost of killowatt-hour to the small customer. The man, from him is increased (even if the customers would not be induced to use more light than they did with carbon lamps). In other words, the saving of expenses caused by the metallic-filament lamps is shared between the customer and the central station, if logical rates are applied, whereas, in case of meter rates, the small customer gets not only all the savings, but even more than that, thus making the central station or, eventually, the large customer, pay for him.

Those small customers, who have already changed to metallic-filament lamps before the change of rates, will experience a raise of lighting cost over their present too low cost and so also

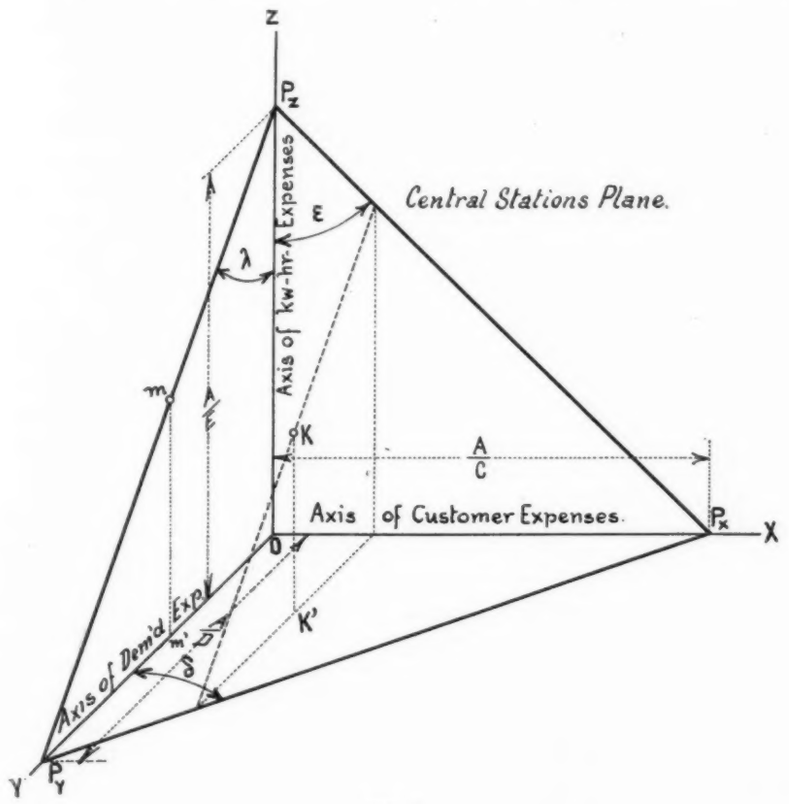



FIG. 1.

who is at present still using carbon lamps, will then see that it is more profitable to use metallic-filament lamps, thus bringing down his cost of lighting below what he paid with carbon lamps on the old rates, in spite of the increase in price per kilowatt-hour. If the new rates are properly devised, the result of the co-operation of the metallic-filament lamp and the new logical rates will be that, although this kind of customer pays less for his light, the profit of the central station possibly will some of the medium and large metallic-lamp customers. The number of medium and large metallic-lamp customers who will find their expenses raised, depends on the details of the meter rates heretofore applied, but, in any case, the small metallic-filament-lamp user will feel an unpleasant effect on his bill, as he will be called upon to pay his full share of expenses, whereas, heretofore, they have been partly paid by other customers.

To recapitulate: most of the carbon-lamp users on a meter basis will be satisfied by a change of rates to more logical ones, whereas the majority of those who have already turned to metallic-filament lamps will be dissatisfied. The use of highly economical lamps is spreading more and more, and, therefore, it seems to be of great and perhaps, in some cases, even vital importance for the electric light companies facing the question of the high-efficiency lamps not only to consider the change of their rates to a more logical basis, but to do it quickly. If the change be delayed until the revenues of the electric light companies are perhaps seriously impaired by the adoption of metallic-filament lamps and until the revision of charges means a revision upwards to the majority of customers, ill-will on their part against the company will be caused and public resentment of the change of rates will be more general.

In view of the actuality of this question of rates, a geometrical aspect of the three-charge-rate system, and an investigation as to how the latter will affect the different classes of customers may be of interest.

THE CENTRAL STATION'S PLANE.

Let $x$ = the customer expense in dollars per customer per year;

$y$ = the demand expense in dollars per kilowatt of maximum demand of the customer per year;

$z$ = the output expense in dollars per kilowatt-hour sold;

$C$ = the average number of **C**ustomers;

$D$ = the sum of the customers' maximum **D**emand[4];

$E$ = the **E**nergy sold per year in kilowatt-hours;

$A$ = the **A**mount of the total expenses for multiple service in dollars.

$A$, $C$, $D$ and $E$ apply to a particular year. Then

$$Cx+Dy+Ez=A \qquad (1)$$

If $x$, $y$ and $z$ are the co-ordinates of a point in a rectangular solid system of co-ordinates, this equation represents a plane $P_x P_y P_z$. (Fig. 1.) Any point

4 Sometimes it is preferred to base the rates on the number of watts installed instead of on the maximum demand, making the simplifying assumption that the maximum demand of a customer is proportional to the capacity of his installation. Maintaining this supposition, none of the following conclusions will be materially changed except that $D$ has to stand for the sum of the installation capacities.

on this plane will fulfill the condition that with $x$, $y$ and $z$ as charges the expenses will be just covered by the income. This plane shall be called *the central station's plane of expenses* (or the *plane of rates* if $C$, $D$, $E$ and $A$ include margins for profit).

We are, therefore, mathematically speaking, entirely at liberty to assume any two of the unknowns and there will always be a corresponding value for the third one—although possibly of an amount not well fitted for practical purposes, or even negative—which, together with the two assumed values, will fulfill the condition that with these three values as charges, under the actual conditions of current consumption during that year, the expenses of that one year would have been just covered. This will be the case if the point, the co-ordinates of which are given by the three assumed "classified expenses" is lying on the plane of that year. (The condition underlying this purely theoretical assumption would be, of course, that the customers would not be influenced to change their consumption of current from what it actually was by such an arbitrary system, where, for instance, the kilowatt-hour charges were negative, and a premium, therefore, be awarded for kilowatt-hour consumption. To avoid these extremes, only that part of the plane shall be considered where all charges are positive.)

For constructing the plane, we have to find out its points of intersection with the three axes. The intersection with the $Z$-axis is found by equating $x$ and $y$ to zero; then

$$Ez_0 = A \text{ or } z_0 = A/E$$

$A/E$ is nothing else than the cost per kilowatt-hour at a *straight kilowatt-hour rate*. Also without mathematical deduction it is clear that if there are neither customer nor demand charges made, all the expenses have to be paid by kilowatt-hour charges. In the same manner the intersection with the axis $Y$ (maximum demand) would be the cost per kilowatt maximum demand, or if we take connected load instead of maximum demand, this would correspond to the *kilowatt flat rate*. The intersection with the axis of $X$ would mean, of course, that all expenses would be divided up between all customers alike by doing away with maximum demand and output charges.

I have been told that this system of rates, which might be called *straight customer's rate*, is (or has been) in use for residential customers in some small towns, where every residential customer has to pay, for instance, three dollars per month irrespective of his kilowatt-hour consumption or his maximum demand. This system certainly has the advantage of eminent simplicity over the kilowatt-hour rate system and even over the flat rate system, and it may be questioned if it is more illogical to base the rates on this one only of the three legs on which a rate system should stand, than on the kilowatt-hour consumption only or the connected load only.

Having determined, therefore, the distance of the three points $P_x$ $P_y$ $P_z$ (see Fig. 1) from the origin $O$, we can draw the plane by descriptive geometry. (Axonometric projection which has been used for all figures in this

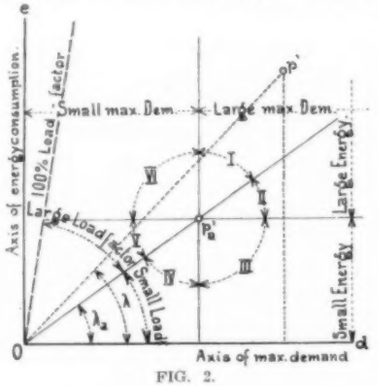



FIG. 2.

article will be found more convenient and clearer than the ordinary orthogonal projection.)

The trace $P_y$ $P_z$ on the $YZ$ plane represents the Hopkinson system in so far as it shows all combinations between maximum-demand charges and output charges which have been theoretically possible in that particular year to just cover the expenses. For instance, if $Om'$ is assumed as demand charge then $m'm$ would have to be the kilowatt-hour charge.

The traces $P_x$ $P_y$ and $P_x$ $P_z$ represent two more possible combinations of charges which, however, to my knowledge never have come into practical use (except in some distorted form such as a minimum charge).

The tangent of the angle $P_y$ $P_z$ $O = \lambda$ is equal to

$$\frac{O P_y}{O P_z} = \frac{\frac{A}{D}}{\frac{A}{E}} = \frac{E}{D}$$

that is, the weighted average load-factor of the customers' use in hours of maximum demand per year or if a correction factor for the diversity-factor, losses, etc., is included, $E/D$ means the load-factor of the central station. Similarly, the tangent of $P_x$ $P_z$ $O$ or $\epsilon$ is $E/C$ and equals the average yearly consumption per customer. The tangent of $P_x$ $P_y$ $O$ or $\delta$ which is equal to $D/C$ is the average maximum demand per customer.

Although, as we have seen, every point on the plane of rates can be theoretically chosen as a rate point yet there is one definite point $K$ on the plane (and one only) which represents the real expenses since each one of the three expenses is a certain definite percentage of the total expenses.

The usual way to find the actual amount of the classified expenses is to analyze the yearly expenses as shown by the company's books and divide each item among the three heads of classification ("customers," "demand" and "output") in a proportion that appears just. Many items will be found to belong to only two or even to one only of the heads of classification. Thus, for instance, repairs on the powerhouse building, interest on the capital invested therein, and depreciation of the building will have to be charged entirely to "capacity," ("maximum demand") whereas the repairs, depreciation and interest on the lines will have to be divided in a certain percentage between "maximum demand" and "customers." By subsequent addition of all the classified items and proportions thereof the three groups, each one of the classified expenses will be found in dollars, giving the values for $Cx$, $Dy$, and $Ez$. Dividing $C$, $D$ and $E$ into these respectively, $x$, $y$ and $z$ are determined as the co-ordinates of the *real point of expenses* or if a profit is included in the expenses[5] as the *real point of rates* $K$[6]. It must be understood then that the other points on the plane of expenses (rates) are only *equivalents* insofar as they would furnish the same amount of income, but they are *not* connected in

5 Since the classified charges are obtained from the classified expenses by increasing the latter by a certain percentage for profit it is not necessary to discriminate between expenses and charges for the present.

6 Although we are not able to determine the real point of rates quite accurately this method is much more accurate than all methods which simply leave out the customer charge $x$ and are working in the $Z$ $Y$ plane only, such as the straight meter rate, the flat rate, the Hopkinson rate.

$x$=the customer expense in dollars per customer per year;
$y$=the demand expense in dollars per kilowatt of maximum demand of the customer per year;
$z$=the output expense in dollars per kilowatt-hour sold;
$C$=the average number of customers;
$D$=the sum of the customers' maximum demand;
$E$=the energy sold per year in kilowatt-hours;
$A$=the amount of the total expenses for multiple service in dollars.

any other way to the actual expenses and their relative ratio[7].

THE EFFECT OF DIFFERENT RATES ON DIFFERENT CLASSES OF CUSTOMERS.

(*a*) *Classification of Customers.*—Moving the rate point on the plane of rates from the point $K$ in any direction, means that certain classes of consumers will have to pay less under the new rates than they did before, while others will be charged heavier than they ought to and will have to pay for the savings of the first-named class.

In order to obtain the law which governs the effect of this displacement of the ratepoint away from the true ratepoint $K$, (or generally speaking, of shifting the ratepoint from one point $P_0$ on the plane to another $P_1$) the following way is available.

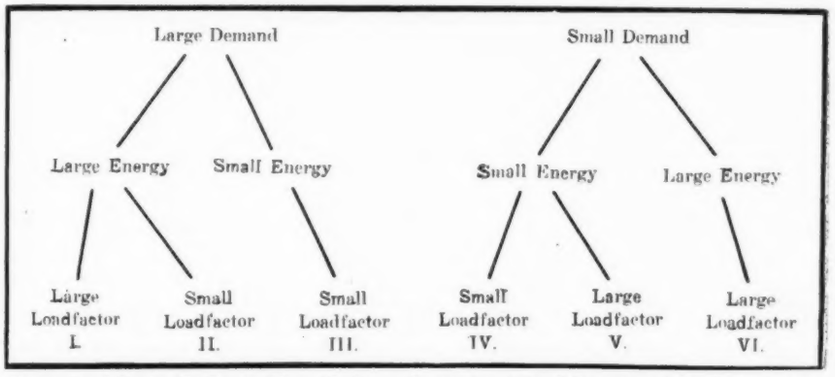
The service a customer demands is characterized by his maximum demand $d$ in kilowatts and his yearly energy consumption $e$ in kilowatt-hours. Instead of stating $d$ and $e$, one of these two values may be replaced by a quantity proportional to the load-factor, $l=e/d$. These three values will be called the *characteristic factors* of the customer; any two of them determine the kind of service he demands. According to these three factors, the consumers can be classified into six classes under the following three headings:

(a) Large and small maximum-demand users.

(b) Large and small energy consumers.

(c) Long and short-hour users.

The terms "large," "small," "long" and "short" hours are used here and later in this article always in comparison to the average values $D/C$, $E/C$ and $E/D$. (Three other classes might be added for such customers whose characteristic factors equal the average, but these are only limiting cases).




Large Load-Factor Is Impossible with Large Demand and Small Energy and Small Load-Factor Is Impossible with Small Demand and Large Energy.

Each customer belongs to one class of each of the three headings, *a*, *b*, *c*. Assuming $d$ and $e$ as variables in a plane system of co-ordinates (Fig. 2) the service of any customer is characterized by a point $p'$ on that plane which will be called the "*characteristic point.*" $l$ is the tangent of the angle $\lambda$.

Comparing $p'$ with the position of the average customer's characteristic point $p'_a$, it is readily seen that there are six combinations of the above six classes *a* *b* and *c* possible (designated I to VI in Fig. 2).

Assuming now one definite combination of charges $x=x_0$, $y=y_0$, $z=z_0$, the customer will have a certain amount $a_0$ to pay per year, where

$$a_0=x_0+dy_0+ez_0 \qquad (2)$$

(*b*) *The Customers' Bills' Plane.*—Changing from the system of co-ordinates $d$, $e$ to a solid system by adding a third axis of co-ordinates $a$, normal to the plane of $d$ $e$, parallel to which are laid off the amounts of the respective customers' bills, this equation means a

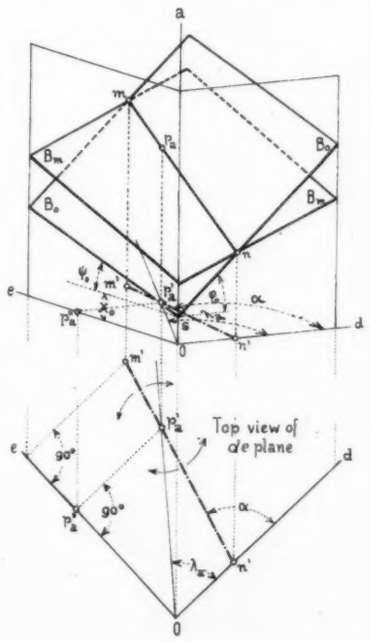



FIG. 3.

[7] Let the conditions of service as given by $A$, $C$, $D$ and $E$ change into $A'$, $C'$, $D'$ and $E'$ the next year and into $A''$, $C''$, $D''$ and $E''$ the third year, then we have the three equations

$$\left.\begin{aligned} Cx+Dy+Ez&=A.\\ C'x+D'y+E'z&=A'.\\ C''x+D''y+E''z&=A''.\end{aligned}\right\} \qquad (1a)$$

and it is clear that if the changes between $C$, $D$, $E$ and $A$ are not proportional there is only one point $P$ ($x$, $y$, $z$) which satisfies all three conditions. It is a great temptation to use the equations (1a) as a means to find the classified charges $x$, $y$, $z$ directly by solving these equations, but unfortunately, if applied in this simple way, this would ordinarily give wrong results, for various reasons. Generally, an investigation into the history of some central station shows that the changes between $C$, $D$ and $E$ actually *are* very nearly proportional, in other words, the average load-factor, the average maximum demand per customer and the average kilowatt hour consumption per customer change but little in the course of several years. These three quantities are given by the tangents of the angles $\lambda$, $\delta$ and $\epsilon$ as has been shown and therefore the planes of equations (1a) will be very nearly parallel to each other, so that a slight inaccuracy will make the point of intersection move far away from where it ought to be. Such inaccuracies are inevitable, for instance, in the expenses in spite of their apparent accuracy. Thus the fuel purchased and the fuel consumed during a certain period do not equal each other, as part of the purchased fuel may have been stored or part of the consumed fuel taken from the stock. A certain large repair which ought to be charged equally to a number of years is charged by the books entirely to the year in which it was done, etc.

If the total yearly expenses $A$ were also changing in proportion to the three other determining factors $C$, $D$ and $E$, the plane would remain identical from one year to the next as the intercepts $A/C$, $A/D$ and $A/E$ would not change their value. As a matter of fact, these three quotients, however, are liable to slowly decrease in consequence of the gradual growth of the plant, the introduction of larger and more economic engines, of automatic stoking and coal-handling devices, simplifications in organization and administrative service, etc. Thus in a certain central station, the consumption of coal alone per kilowatt-hour sold went down from 5.6 pounds in 1900 to 4.4 in 1904 and 3.5 in 1909 (cost 1.63, 0.95 and 0.76 cents). In another central station the figures of which are within my reach, the total operating expenses per kilowatt-hour sold in the same three years were 4.00, 2.26 and 1.26 cents.

This means that the whole plane is being drawn downwards towards the origin of co-ordinates and the classified expenses $x$, $y$, $z$ are slowly decreasing. This is one other reason why we cannot use equations (1a) for determining $x$, $y$ and $z$. (We cannot take care of this gradual change of the classified expenses otherwise than by readjusting the charges from time to time according to the changed conditions, as is actually the practice in many companies.)

I have partly overcome these and other difficulties and am still working at the problem but there seems to be little hope for the development of that method for general practical use.

plane in space which shall be called the *customer bills' plane* $B_o$ in Fig. 3[8].

In order to find the traces of this plane on the $a$ $d$ plane of co-ordinates, let $e=0$ in equation (2), which makes

$$x_o+dy_o=a_o,$$

which is the equation of a straight line in the plane of $d$ $a$ starting from the $a$-axis at the distance $x_o$ from the origin $0$ and rising at an angle $\phi_o$, the tangent of which is $y_o$. In a corresponding way it will be found that the trace on the $a$ $e$ plane rises at an angle $\psi_o$, the tangent of which is the kilowatt-hour charge $z_o$.

Let now the point of rates $P_o$ ($x_o$, $y_o$, $z_o$) be shifted to $P_m$ ($x_m$ $y_m$ $z_m$) Fig. 4, with the corresponding customers' bills' plane $B_m$ (Fig. 3).

$$a_m=x_m+dy_m+z_m$$

(It should be kept in mind that there is one definite plane of customers' bills for every set of charges $x$, $y$, $z$, and that for every customers' bills plane $x$, $y$ and $z$ are *constants*, for instance, $x_o$ $y_o$ $z_o$ or $x_m$ $y_m$ $z_m$, etc., whereas the variables are $d$, $e$, and $a$.)

(c) *The Line of Unchanged Bills.*—The two planes, $B_o$ and $B_m$, will generally intersect in a straight line $mn$ (Fig. 3). The projection of this line on the $de$ plane will be $m'n'$ and any customer whose characteristic point is situated on $m'n'$ will have to pay neither more nor less under the new rates (rate point $P_m$) than he did under the old ones ($P_o$) since $a$ is the same on both planes for these consumers; this line $m'$ $n'$, therefore, shall be called the *line of unchanged bills*. All customers whose characteristic points are on one side of $m'$ $n'$ will see their bills reduced by the change of rates, while those on the other side will experience an increase of their bills.

To find the equation of $m'$ $n'$, set $a_o=a_m$ in the equations for $B_o$ and $B_m$ and eliminate $a_o=a_m$ from both equations. Thus we get

$$x_o+y_od+z_oe=x_m+y_md+z_me \qquad (3)$$

or $$e=\frac{y_o-y_m}{z_m-z_o}d+\frac{x_o-x_m}{z_m-z_o} \qquad (3a)$$

The condition that $P_o$ ($x_o$ $y_o$ $z_o$) and $P_m$ ($x_m$ $y_m$ $z_m$) both are on the plane of rates (Fig. 4) is

$$Cx_o+Dy_o+Ez_o=A \qquad (1_o)$$

$$Cx_m+Dy_m+Ez_m=A \qquad (1_m)$$

or by substraction

$$C(x_o-x_m)+D(y_o-y_m)+E(z_o-z_m)=0. \qquad (1^*)$$

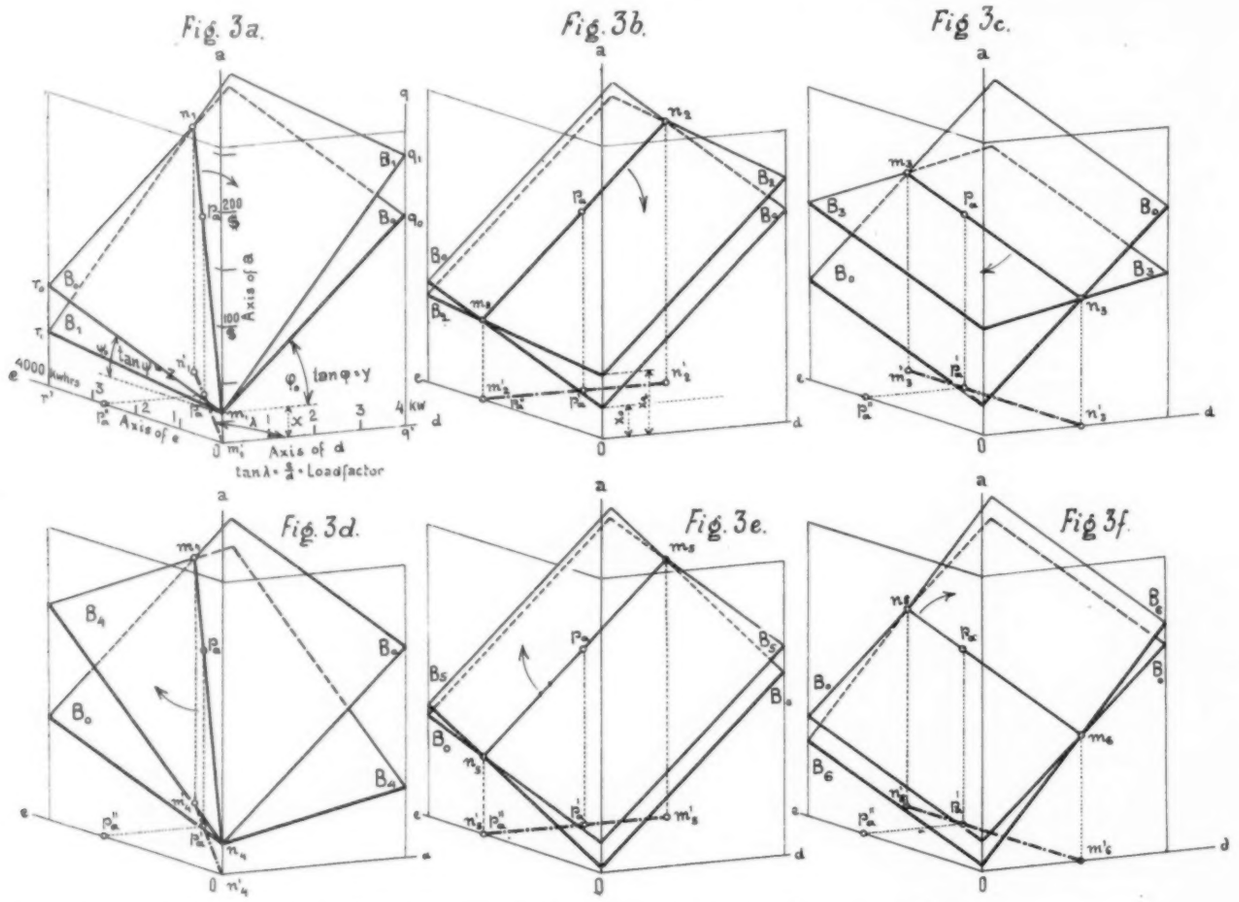
Introduce this condition by substituting $(x_o-x_m)$ from this equation into (3 a) and reduce:

$$e-\frac{E}{c}=\frac{y_o-y_m}{z_m-z_o}\left(d-\frac{D}{c}\right)$$

This is the equation of a straight line in the plane of $d$ $e$ which passes through the characteristic point $p'_a$ of the average customer ($d=D/c$, $e=E/c$) and is inclined at an angle $\alpha$ to the axis of $d$, the tangent of which is

$$tan\ \alpha=\frac{y_o-y_m}{z_m-z_o}$$

No matter, therefore, where $P_o$ and $P_m$ are situated on the rates plane the "line of unchanged bills" $m'$ $n'$ will always pass through the characteristic point of the average customer; *the bill*




[8] In looking at Figs. 3 to 3f, it should be understood that the planes of coordinates are not opening toward the observer, but away from him so that they are seen, as it were, from the back. In other words, the axis of $a$ is next to the observer instead of farthest away from him; this has been found desirable to make the drawings clearer in this case. The planes of coordinates, however, would conceal the rest of the figure and therefore have been assumed to be entirely transparent. For additional clearness, a top view of the $d$ $e$ plane of Fig. 3 has been added below this figure.

$x$=the customer expense in dollars per customer per year;
$y$=the demand expense in dollars per kilowatt of maximum demand of the customer per year;
$z$=the output expense in dollars per kilowatt-hour sold;
$C$=the average number of customers;
$D$=the sum of the customers' maximum demand;
$E$=the energy sold per year in kilowatt-hours;
$A$=the amount of the total expenses for multiple service in dollars.

*of the average customer is not affected by any change of rates on the plane of rates.*

(*d*) *Determination of Which Classes of Customers are Favored by Different Rates.*—Returning to Fig. 4 we can easily find another meaning for this angle $\alpha$. Projecting the connecting line $P_o P_m$ on the $Y Z$ plane we get $P_o' P_m'$ and the above expression $(y_o - y_m)/(z_m - z_o)$ now is the tangent of the angle $P_o' P_m' P_m''$

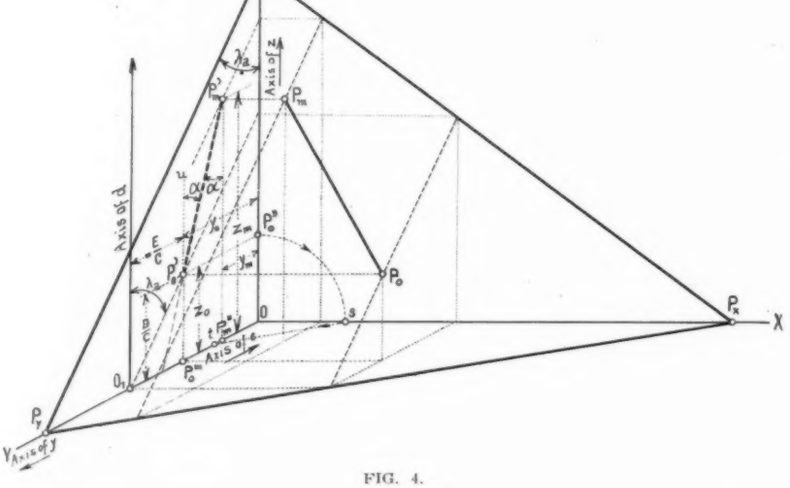



FIG. 4.

or also of the angle $u\ P_o' P_m'$, therefore the angle $u\ P_o' P_m' = \alpha$.

If we consider $P_o$ as being fixed and compare all possible situations of $P_m$ on the plane of rates with it, carrying $P_m$ round about $P_o$ in all directions, the line $P_o' P_m'$ will revolve around $P_o'$ in the $YZ$ plane, while at the same time in Fig. 3, the "line of unchanged bills" $m'\ n'$ will revolve around point $p_a'$ at exactly the same angular velocity, since the angle $\alpha$, as we have seen, will always be the same for both lines. This fact enables us to use the projection $P_o' P_m'$ in Fig. 4 directly as representing the line of unchanged bills $m'\ n'$ from Fig. 3 by drawing the system $de$ of co-ordinates right into the $YZ$ plane in the proper way. Since the angle $\alpha$ represents the inclination between the line $P_o' P_m'$ and the axis of $Z$ and also between the same line and the axis of $d$ it follows that the axis of $d$ will have to be drawn parallel to the axis of $Z$ and consequently the axes of $e$ and $Y$ will also be parallel to each other, and there only remains the question where the point $O_1$ of that new system of co-ordinates $de$ should be located.

It is seen from Fig. 3 that the line connecting $O$ and $p_a'$ includes the angle $\lambda_a$ with the axis of $d$, where $tan\ \lambda_a = l_a =$ average load-factor. On the other hand, we find the same angle $\lambda_a$ in Fig. 4 as the angle between the trace on the $YZ$ plane and the axis of $Z$. The origin $O_1$ of the new system of co-ordinates $d$ and $e$ will therefore have to lie somewhere on a parallel to $P_y P_z$ drawn through $P_o$. Exactly on which point of this line $O$ is situated depends entirely on the scale chosen for $d$ and $e$. (Since the scale for the load-factor is given by

$$tan\ \lambda_a = \frac{E}{D}$$

we are left only the discretion of assuming the scale for either $d$ or $e$ and we might just as well as not choose this scale in such a manner that the axis of $e$ coincides with the axis of $Y$, that is, the scale is chosen so that the average energy consumption $e_a = E/C = P_o''' P_o'$ = the length of the line representing the kilowatt-hour charge $z_o$[9].)

9 Stepping off $z_o$ from $O$ on the axis of $X$ to point $s$ and drawing a parallel to the trace $P_x P_y$ through this point which will intersect the axis of $y$ at $t$ we get $Ot$ as unit for $d$, since

$$\frac{Os}{Ot} = \frac{OP_x}{OP_y} = \frac{\frac{A}{C}}{\frac{A}{D}} = \frac{D}{C} = d_a$$

$$\frac{z_o}{Ot} = \frac{OP_x}{OP_y} = d_a$$

and since $z_o$ must equal $d_a$, $Ot$ = unit.

To make matters clearer the plane in question has been reproduced in Fig. 5 at proper proportions and angles instead of the oblique projection in Fig. 4.

It must be quite clearly understood that we are having two distinctly different systems of co-ordinates in the same plane of $YZ$. One is the system with the origin $O$ giving the charges $y$ and $z$ for the whole system in dollars per kilowatt and cents per kilowatt-hour; the other one, with $O_1$ as origin, is the system for the individual customers' maximum demand in kilowatts and energy consumption in kilowatt-hours.

$P_o' P_m'$ represents, if referred to the system $YZ$, the projection of the connecting line between the old and the new ratepoint $P_o$ and $P_m$ and if referred to the system of $de$ it represents the corresponding position of the line of unchanged bills, whereas $P_o'$ being the projection of the original ratepoint in the $YZ$ system is the characteristic point $p_a'$ of the average customer if referred to system of $de$.

By moving the point of rates $P_o$ on the plane of rates in a certain direction certain classes of consumers will see their bills decrease and the rest will experience an increase in cost of electricity. It is evident now from what has been deduced so far that if the point of rates be moved still farther away in *the same direction* the same classes of customers who had been favored by the change so far will continue to be favored, and *vice versa* as the line of unchanged bills remains the same. In other words, whether a certain class of customers, characterized by their maximum demand and energy consumption $d$ and $e$, will profit or lose by a change of rates depends solely on the direction in which the point is shifted and not on the distance from its original position.

The next important question is on which side of the line of unchanged bills the customers are favored by the change of rates and on which side they will find their bills increased. Instead of general algebraic deductions, I consider it preferable to demonstrate this by a sys-

tematic series of appropriately selected examples, a method which although less scientific and less general still is clearer and shorter, at the same time giving some interesting special cases.

For this purpose we move a point $P_m$ on the plane all the way round $P_o$ and examine particularly what the effect on the cost of electricity will be if the point is moved in one of the three main directions parallel to one of the three planes of co-ordinates; in other words, so that first the customer charges remain constant while $y$ and $z$ are changed, then $P_o$ is shifted so that the demand charges are unaltered while $x$ and $z$ change and finally the same for constant output charges $z$.

Thus the cost of electricity to the customer will be compared first between the ratepoints $P_o$ and $P_1$ (See Fig. 6), then between $P_o$ and $P_2$, $P_3$, $P_4$, $P_5$ and $P_6$ successively.

Fig. 6 is taken from actual practice and represents the conditions in a large

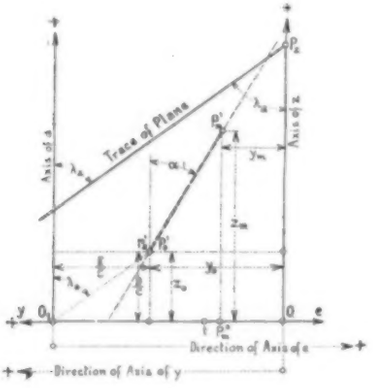



FIG. 5.

central station of this country; the numerical values are set down in the figure itself. $P_o$ has been chosen in this example as the "real point of rates," the co-ordinates of which had been found by analysis, and their values are given in the first line of the little table in Fig. 6. On the right side of this table are given the characteristic factors of the average customer.

$A$, $C$, $D$ and $E$ determine the plane of rates (Fig. 6). The intercepts of the plane on the three axes are

$A/C = 153.70$ dollars per customer.

$A/D = 71.10$ dollars per kilowatt.

$A/E = 5.66$ cents per kilowatt-hour.

Fig. 3a shows the customers planes $B_o$ and $B_1$ for points $P_o$ and $P_1$ in Fig. 6; the ordinates $a$ of plane $B_o$ therefore show what each customer ought to pay according to the expenses he causes; $x$ is the same for both points and since, as has been demonstrated, $x$ is represented by the distance $Os$ (Fig. 3), corresponding to $Om_1$ in Fig. 3a, it must follow that both planes will intersect the axis of $a$ in the same point. The line of intersection $m_1n_1$ between $B_o$ and $B_1$ will therefore pass through the axis of $a$ and the projection $m'n'$ of this line representing the line of unchanged bills will issue from the point $O$. It has been shown that the line of unchanged bills has to pass through the characteristic point $p_a'$ of the average customer and in this case it will represent therefore the line of the average load-factor. (See top view of $de$ plane in Fig. 3.) A glance at Fig. 3a shows that for all customers whose load-factor is larger than the average, $B_1$ has a lower ordinate $a$ than $B_o$: their bills will be reduced by the change of rates below what they ought to be, and the reverse for customers with small load-factors. The absolute value of the individual customer's demand and energy consumption has no bearing whatever on the question whether this customer will be favored.

Fig. 3b shows what happens if $P_o$ is shifted from $P_o$ to $P_2$ (Fig. 6) for constant $y$. $y$ is represented by $tan\ \phi$, and therefore the trace of $B_2$ on the $ad$ plane will have to be parallel to that of $B_o$. Consequently the line of intersection $m_2n_2$ will be parallel to both these traces and the line of unchanged bills $m_2'n_2'$ will be parallel to the axis of $d$. Plane $B_2$ is lower than $B_o$ for all points on the $de$ plane where $e$ is larger than the average, therefore all customers with a large energy consumption will be favored by the change of rates irrespective of what their maximum demand is. Accordingly all customers with a small energy consumption will be penalized.

Changing over to point $P_3$ (constant $z$) we see similarly, from Fig. 3c, that any customer irrespective of his energy consumption or load-factor will be favored as long as his maximum demand is larger than the average and *vice versa*.

The next point is $P_4$ lying just opposite $P_1$ on the other side of $P_o$. Fig. 3d shows that the line of demarcation $m'n'$ between favored and penalized customers (line of unchanged bills) again is the line of average load-factor, the same

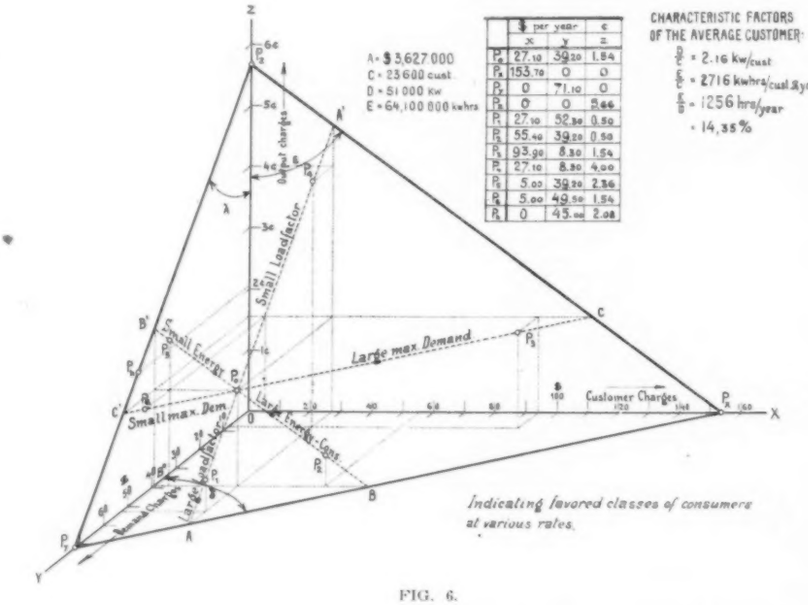



FIG. 6.

as in Fig. 3a, but turned around $p_a'$ by 180 degrees; now conditions are just the reverse from what they were at ratepoint $P_1$. In shifting from $P_o$ to $P_1$, $y$ is increased and $z$ decreased, accordingly in Fig. 3a $\phi_1$ has to be larger than $\phi_o$ and $\psi_1$ smaller than $\psi_o$ (since $tan\ \phi = y$ and $tan\ \psi = z$). The reverse holds true for point $P_4$; in other words, where increases of the bill had taken place for point $P_1$ reductions will take place in case of $P_4$ and *vice versa;* shifting the ratepoint to point $P_4$ means a premium to the small-load-factor customers at the expense of the long-hour users.

It can be seen from the drawings how shifting the point toward $P_5$ means favoring the small-energy consumers and towards $P_6$ the small-maximum-demand users.

Fig. 4 will also show how by shifting

$P_m$ all around $P_o$, $P_o'$ $P_m'$ revolves around $P_o'$ (corresponding to the average customer's characteristic point $p_a'$). It can easily be seen here how by leaving first $x$, then $y$, and finally $z$ constant and changing only the two other co-ordinates (charges) the projection $P_o'$ $P_m'$ will be swinging into the three main positions of constant load-factor (parallel to trace $P_y$ $P_z$) constant $e$ (parallel to axis of $Z$ or $d$ respectively) and constant $d$ (parallel to axis of $y$ or $x$ respectively). Shifting the ratepoint in intermediate directions will turn the line of demarcation between favored and penalized customers in an intermediate position (always passing through the average customer's characteristic point), such as for instance $P_o'$ $P_m'$ in Fig. 5. This position $P_o'$ $P_m'$, for instance, which is lying between the main positions favoring small-load-factor consumers and small-energy consumers would mean that such customers are favored who fulfil one of the following conditions:

(1) Both load-factor and energy consumption are small: $\lambda$ less than $\lambda_a$ and $e$ less than $E/C$.

(2) The load-factor may be large, but then the energy consumption must be all the smaller and be below a certain limit, which in any case is smaller than the average energy consumption and is the smaller the larger the load-factor ($tan\ \lambda$) is.

(3) The energy consumption may be large, but then the load-factor must be below a certain limit, which is the smaller the larger the energy consumption is.

It is easy to see how this applies *mutatis mutandis* to all other intermediate positions of the line of unchanged bills.

*(To be continued.)*

## Exports of Copper.

Exports of copper for the week ending February 2 were 6,900 tons. Since the first of the month the figure has been 3,638 tons, as against 5,332 tons for the same period of last year. This shows a decrease.

Exports of copper for the month of January amounted to 29,257 tons, as against 26,699 tons for January of last year.

The exports of copper from the United States amounted to an aggregate value of nearly $89,000,000 in 1910, compared with about $89,400,000 in 1909.

Exports of copper for the week ended January 26, were 5,000 tons.

## Commercial Motor Vehicle Exhibition.

Light package delivery machines, heavy trucks capable of hauling ten tons at a single load, motorcycles, and accessories required by these vehicles were demonstrated at the Commercial Motor Vehicle Exhibition held in the Coliseum, Chicago, February 6 to 11, under the auspices of the National Association of Automobile Manufacturers.

This was the first show of the kind ever held in Chicago and its importance may be realized from the fact that over 225 exhibitors participated, exhibiting power propelled carriers and accessories that demonstrated the remarkable strides that have been made in the industry.

The show was replete with novelties. One of these, which attracted unusual attention, was an electrically propelled hearse that is in the regular service of a Chicago undertaker. There were also a number of different makes of police patrol wagons and motor ambulances, both gasoline and electric, suitable in size and price for large and small cities. An extraordinary amount of interest has developed throughout the country this winter in motor wagons for municipal purposes and undoubtedly one result of the Chicago show will be a noticeable increase in the number of such machines in different cities during the present season.

One of the most unique forms in which the commercial motor vehicle appears is an industrial truck designed especially for use in factories and warehouses and at railroad stations and steamship docks for hauling trunks and freight. These are electrically operated and are made in several styles and sizes, some running on four and others on three wheels. Their platforms are only two feet above the floor and their maximum speed is four miles per hour. They have a carrying capacity of from two to four tons.

The interior decorations and lighting schemes of the Coliseum and Coliseum Annex during the motor wagon show were the same as for the Automobile Show the previous week. Also the manufacturers of accessories exhibited the same materials as during the first week. A brief account of the exhibits of electrical interest was given in our last issue. The following is an account of the exhibits of electric vehicles during the motor-truck exhibition:

Anderson Electric Car Company, Detroit, Mich., exhibited two 2,000-pound delivery wagons and the chassis of a 1,000-pound wagon. All were shown equipped with Edison batteries. The normal speed of these cars is said to be twelve miles per hour.

Automobile Maintenance & Manufacturing Company, Chicago, Ill., manufacturers of the Walker balance-gear electrics, exhibited two of these machines—one a covered delivery wagon and one a 1,500-pound truck. The rear wheels of these trucks are hollow and contain the driving gears which are operated by a pinion at each end of the motor shaft.

Baker Motor Vehicle Company, Cleveland, O., exhibited a two-ton truck, complete, and a 1,000-pound delivery wagon.

Couple-Gear Freight-Wheel Company, Grand Rapids, Mich., had on exhibition a five-ton gas-electric truck. This was of the four-wheel drive type equipped with a driving motor in each wheel. In addition there was shown a half section of the wheel in operation showing the method of driving.

General Vehicle Company, Long Island City, N. Y., had on exhibition one of its five-ton trucks and a closed delivery wagon. There were also shown a number of photographs of other types and photographs of General vehicle trucks operating under severe conditions.

Lansden Company, Newark, N. J., had a very complete exhibit of its commercial vehicles, including a one-ton express wagon, as supplied to the Adams Express Company, two model delivery wagons of 1,000-pound capacity, an electric ambulance, completely equipped, and the Lansden flat truck for use at wharves, railroad stations, in factories, etc. An interesting feature of the exhibit was the electric wagon owned by the Adams Express Company which in 1904 made the trip from New York to Washington, D. C., and has been in continuous service ever since.

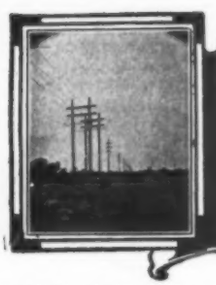
Studebaker Automobile Company, South Bend, Ind., had on exhibition, among its gasoline trucks, a Model 26 truck, a Model 25 delivery wagon, a Model 28, three-ton truck and the chassis of a Model 24 seven-ton truck.

Waverley Company, Indianapolis, Ind., had on exhibition an electric hearse, an electric ambulance and a light delivery wagon.

## Parade of Commercial Trucks.

A unique parade, composed entirely of commercial motor trucks, was held in Chicago Monday, February 6, in connection with the opening of the first annual Chicago commercial motor vehicle exhibition. Despite a severe snowstorm, which promised to blockade the business thoroughfares of the city, the parade was held and pronounced a marked success—first, because the representative display of vehicles demonstrated the extent to which Chicago merchants are employing motor vehicles, and secondly, because the snow-covered streets proved no hindrance to the parade and demonstrated the value of the motor vehicle in inclement weather.

About 150 commercial vehicles of all types were in line, and they ranged in size from the 1,000-pound delivery wagon to the five-ton truck, both gasoline and electric.



# CENTRAL-STATION PRACTICE

## Transmission—Interior Wiring

## ELEMENTS OF POWER-STATION DESIGN—XXII.

DISTRIBUTION SYSTEMS—II.

BY W. B. GUMP.

(e) *General Design of Feeder Systems.*—The design of feeder systems embraces practically the entire substation layout, and is far too broad a subject to treat within these few pages except in basic form. While the art of distribution has rapidly advanced, and the problems relating to the maintenance of fixed potentials at remote distributing points have reached a solution, yet these problems are still puzzling and in a measure unsolved in the case of large networks in thickly populated districts; more especially in connection with power used for transportation. A thickly congested district in which the load continually fluctuates is perhaps the most stubborn condition confronted by the electrical engineer. The power requirements form one part of the problem and the method best suited to its distribution is the other part. The latter is apt to be more complicated, and therefore more difficult of analysis.

The general arrangement of feeders carried to a distributing point is too well known to require details. It is at once evident that in a large distributing system, the potential at each distributing center must vary according to its particular load, hence independent regulators at each distributing point become necessary.

Fig. 11 shows an elementary circuit in which there are two distributing centers; namely, *A* and *B*. With the system uniformly loaded the potential diagram given in Fig. 12 shows the extent of drop at different distances from the distributing points. Assuming, now, that the load at *B* becomes abnormal (as might be the case with an electric railway), the potential must be raised on the outer feeder, if normal voltage is required at *B*. To affect this result demands some form of regulator on this particular feeder. As regards a railway load it is often impossible to provide for full potential under conditions of extreme congestion. In the case of lighting however, the matter of maintaining normal voltage at the consumers' circuits is extremely important, and must be well provided

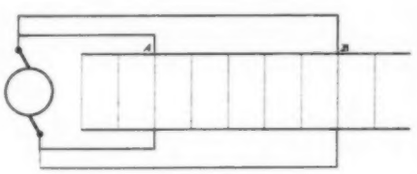


FIG. 11.

for, if satisfactory service is to be realized.

In order to design a feeder system properly, a careful study of the community in question is necessary. Accurate maps are very essential in laying out the system, and these maps should contain all of the data which is available at the time the design is started. While the surveys do not serve to show the future growth, they do form an accurate basis for determining the initial loads sufficiently close for practical purposes.

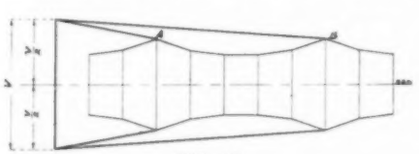


FIG. 12.

(f) *Regulators, and Auxiliary Devices.*—Feeder regulators are of two general types:

(1) Step by step, or switch type.

(2) Induction type.

Either of these types may be hand-operated, or automatically controlled, and may be single-phase, or polyphase. In either type there are two windings, one in series with the line being regulated, and the other across the line, and usually termed the primary winding. In the switch type, the coils are stationary. Taps are brought out from the series coil, portions of which may be cut in or out, thereby altering the secondary potential which is in series with the load.

The induction type of regulator has found much favor, and is being installed extensively, especially where automatic control is desirable. The construction of this type consists of a stationary and a movable set of poles, the primary portion being wound upon an inner drum which is permitted to rotate, taking a position which reinforces or opposes the magnetic field, and hence "boosts" or "bucks" the potential.

In deciding upon the question whether to use automatic or hand-operated regulators, it may be said that this depends largely upon the operating conditions. Where a switchboard attendant is well able to manipulate a set of regulators by means of remote-control switches, this method may be superior to automatic control. In very large stations, however, especially where the amount of power per feeder is large, automatic control is always to be considered seriously. This applies especially to rapidly fluctuating loads which cannot be properly taken care of by means of manual operation. Where a polyphase circuit is unbalanced single-phase regulators should be used, if close regulation is desired.

The arrangement of regulators within the station is a very important item, since proper provision for extensions must be made, if cramping and inconvenient operation are to be avoided later. Whether the regulators are located in the basement or on the main floor depends chiefly upon local conditions. Since the heat radiated must be disposed of, it becomes necessary to give this item due consideration. Where water circulation is used, the piping system should be very carefully

planned. Main conductors leading to the regulators should be segregated from neighboring conductors, and the control wiring should be carried in independent ducts well protected from the effects of heat and moisture. It is important to note that ample space should be given for manipulating the regulators, such as removing them for repairs, or working upon them while in place. Failure to allow ample space is certain to hinder operation, and is likely to increase the fire hazard.

Where regulators are installed upon the main floor the main leads can generally be carried in the floor, and distributed to the individual regulators. The control wiring can be carried in separate ducts above, or supported within a concrete wall.

Auxiliary devices include relays for actuating the regulators, potential and current transformers for the feeders, water-cooling system (if one is used), switches or other appliances operated in conjunction with the regulators. It should be noted here that the current transformers which operate feeder ammeters are connected in the outgoing lines, and hence are located near the regulator. Potential transformers, however, may be located at any convenient place where the secondary wiring can be extended to the switchboard. Wiring from current transformers and from potential transformers, respectively, should run independently to the switchboard, and should not be placed where there is possible interference with other wiring.

Where constant-current transformers are installed the same general considerations should be given as those referring to feeder regulators. In case the number of arc-lighting circuits to be fed is very large, it is apt to involve difficulty in accommodating the wiring. This can generally be overcome by running each wire in a fiber conduit, and grouping the outgoing conduits in a bundle. The entire mass of conduits may be imbedded in concrete walls, floors, or columns, and be led out of the building with as fireproof a construction as other portions of the installation.

On account of the number of arc-light transformers which are required in a large substation it is generally out of the question to arrange them in one row, or even in a double row. For this reason, some method of lifting them out must be provided, as well as allowing space for moving parts, and access for handling. In case it becomes advisable to place these transformers in a basement, a crane should be operated overhead within the basement, or an opening left in the main floor through which the main crane may hoist any of the transformers. The latter arrangement, however, is likely to complicate the wiring, and in not a few cases presents a very perplexing situation.

(*g*) *Outside Construction and Maintenance.*—The line construction, underground work, and individual service installations go to make up a large investment, and the question of reliability stands at the head of the list of items. The fact that outside construction should be first-class is well known. Too often, however, it is slighted in order to cut down the first cost, and this is done at the expense of greatly increased maintenance charges.

Underground construction has been treated in a previous chapter. Overhead lines do not deserve a detailed description here. These things having been properly attended to, the next question is that of the service meters. In this connection it should be stated that a first-class meter department is absolutely necessary in any power system, and this feature cannot be overlooked if the service is to be satisfactory. The importance of regular and systematic calibration of watt-hour meters is now recognized, and scarcely needs further comment. Such a department should be attended to by specialists who have no other duties. An exception would be where a plant is too small to permit the attendant or attendants to devote full time to meters alone. A number of such cases are to be seen in towns of from 1,000 to 6,000 inhabitants, in which the community is supplied from a central steam plant.

Pole-top transformers, as well as subway transformers, should have their cases grounded so as to protect linemen, and where it is feasible pole-top switches are advisable for use in cutting out a particular section which is being repaired. This arrangement has the distinct advantage of assurance against live conductors.

(*h*) *The Financial Side.*—The economical aspect of distributing systems is far too broad to admit of an analytical discussion here, further than to deal with a few of the fundamental factors, showing the course to be pursued in planning a system of electrical distribution.

There are a large number of factors entering into this question and these factors are conflicting in their relation to economy. Among the factors pertaining to electrical conductors for distribution may be mentioned:

(1) Safety from overheating.

(2) Mechanical strength.

(3) Minimum first cost of line construction.

(4) Minimum first cost of central station.

(5) Minimum cost of operation.

(6) Maximum income at minimum cost.

The first two items are required in any distributing system, and need no comment. Item (3) will be seen to conflict with item (4), from the fact that, if minimum line cost alone is considered, the line losses will have to be made up at the power station, thereby increasing the cost of the latter. This assumes that the plant is to run twenty-four hours per day, which is usually the case. A temporary plant, or one which is to operate only a small portion of the time, would obviously profit by a minimum cost of line, and in the event of discontinuing service the salvage from the line would be very small, while that of the station apparatus would be comparatively high; especially is this true if the machinery is to be installed elsewhere. It is apparent that in such a case the machinery may be practically as good as new, and the cost of removal is apt to be small, while the original line has little more than scrap value.

It is plain that item (4) cannot be considered alone. Since the cost of the losses before mentioned should be reduced, and this can only be done by increasing the amount of copper, minimum station cost becomes physically impossible. This is due to the fact that the losses can be reduced to zero, only by installing a maximum amount of copper for a given output, corresponding to maximum and not minimum station cost. On the other hand, if the losses are increased, the inefficiency must be paid for in the station, which is increased in order to supply the given output. A study of these conflicting conditions shows that a balance must be struck which will allow the annual cost of energy losses, plus the

annual investment charges, to be a minimum.

Minimum cost of operation involves a relation such that the annual cost of the conducting system, and the annual cost of station equipment, are adjusted to give a minimum total cost of operation. This relation will be found by analyzing the annual interest and depreciation of the conducting system, and the annual interest and depreciation of the station, and striking the proper balance. The process of finding this condition is complex, and is the basis of Kelvin's Law. A former chapter touched upon this law, stating that due care must be exercised in determining the proper compromise between theory and practice.

The last item is the one invariably sought, and is the factor to which all other considerations should contribute. As stated in the above list of items it is misleading, and should read "Maximum income for a given investment," for a maximum income cannot be realized from a minimum investment. It might also be made to read "A minimum investment for a fixed profit." In either case it is apparent that one factor may be regarded as a constant, and the other a variable, as far as the process of solution is concerned.

In conclusion it is well to state that the cost per kilowatt-hour of energy delivered to individuals, such as residents, necessarily involves the cost, interest charges, depreciation and maintenance of the entire conducting system. This is why a power company prefers to supply a large block of power to a single customer, rather than small amounts to a large number of customers. This feature enters intimately into the question of lighting rates, where the cost per kilowatt-hour at the switchboard is necessarily a very different matter from the cost of energy delivered to small consumers in outlying districts.

*(To be continued.)*

## Destruction of Minneapolis Power Plant.

In our issue of January 14 we called attention to the destruction by fire of the East Side power house of the Minneapolis General Electric Company, which was completely burned on the morning of Friday, January 6.

On the morning in question a single engine was operating at this station and for some unknown reason it began racing and soon flew to pieces, before the engineer in charge had time to shut it down. Immediately afterwards fire broke out, completely ruining the plant. It is believed that this fire was due to a short-circuit on the incoming mains.

The accompanying illustrations have been made from photographs taken immediately after the fire. Fig. 1 shows the interior of the plant with the switchboard to the right and above. The base of this board and the holes in the wall show the level of the main floor. Fig. 2 is a view taken from the other end of the building. To the right may be seen a Filers-Stowell engine and a General Electric three-phase generator of 1000 kilowatts capacity of 2,300 volts. The engine bed was cracked in five different places. The machinery was completely wrecked.

A new substation is to be built upon the site of the old power house and a new 10,000-kilowatt steam power plant will be erected upon a new site in the vicinity. This has already been decided upon and Stone & Webster have started upon the work for the construction of the new plant. $1,270,000 has been set aside for this purpose.

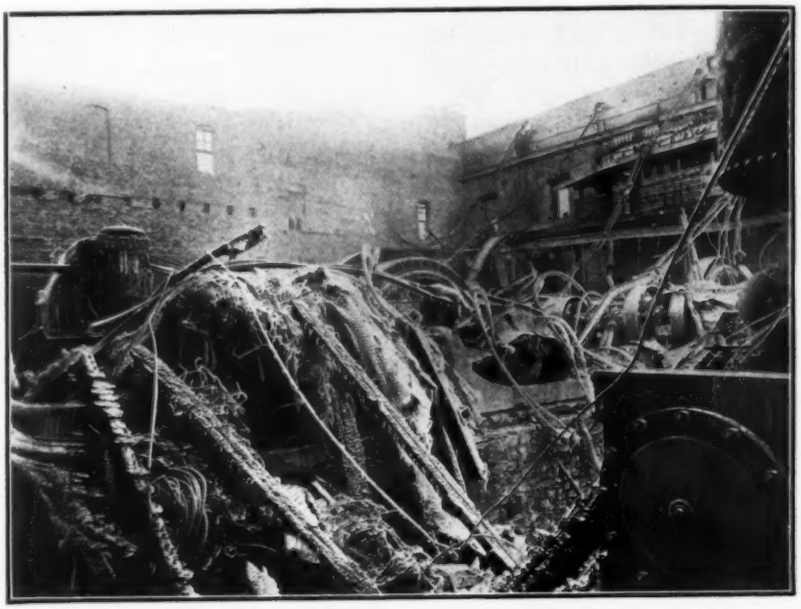


FIG. 1.—RUINS OF POWER HOUSE SHOWING SWITCHBOARD INTACT.

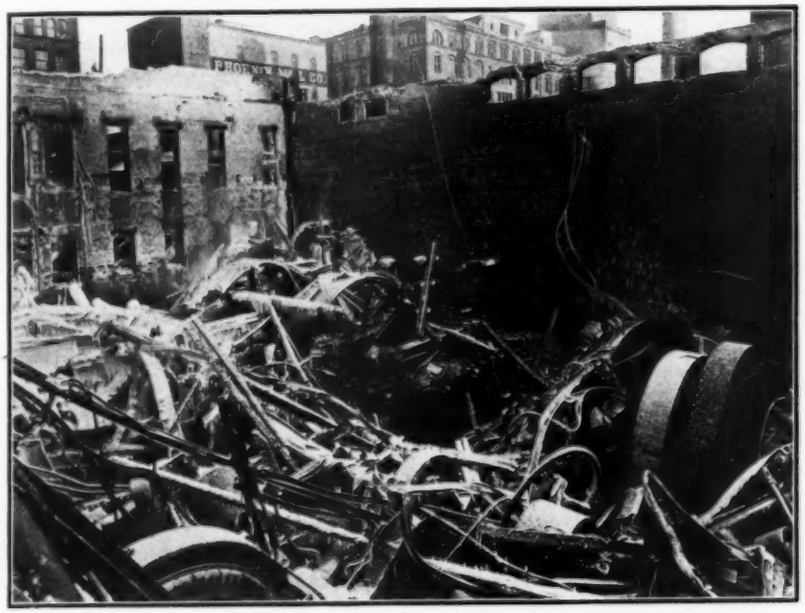


FIG. 2.—VIEW FROM OTHER END OF POWER HOUSE.

# ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

**Flaming-Arc Lamps for Shop Lighting.**

At a meeting of the Toledo Section of the American Institute of Electrical Engineers held at the Y. M. C. A. Building, Toledo, Ohio, on the evening of February 3, Harry Caird made an address on the subject of "Illumination." Mr. Caird is engineer for the Excello Arc Lamp Company at Chicago and his address dealt largely with the subject of flaming-arc lamps for shop lighting.

Mr. Caird stated that architects used to incorporate into their plans for shops a certain number of lights, no matter what kind of lights were used. The conditions prevailing in the rooms were usually not taken into consideration. Such is no longer the case and it is up to the engineer to determine what lights and how many will be most effective in certain rooms under certain conditions. One shop owner will have his walls whitewashed, another will have them finished to match the dark iron girders. This and a hundred other incidentals will affect the conditions which must be considered in the scientific lighting of a shop. Different illumination is required for high and low-speed machinery. Different kinds of light are required for shops where colored articles are used from those where no colored articles are to be found. These are but a few of the many conditions which confront the lighting engineer and in which each shop is peculiar to itself and it is evident that such problems require judgment and experience to figure out properly.

The speaker expressed the opinion that the higher a lamp is hung in a shop the more light it will give. He was emphatic in his opinion that the direct-current lamp is much better for use in a factory where high speed is used than the alternating-current lamp as with the latter lamps shadows are cast on the machines while in motion. If the machine moves as rapidly as the arc it causes a shadow. In the direct-current lamps no shadow is noticeable as the current is always in one direction. This applies especially to shops where lathes and spinning machines are installed. Mr. Caird stated that the alternating-current lamps are satisfactory for low-speed machines. Either forty or twenty-five-cycle lamps may be used and good results secured.

The flaming-arc lamp, which Mr. Caird was advocating as the best lamp for shop-lighting purposes, is hung high and generally over the cranes. As the foreman complained that they did not like to stop work every time it was necessary to trim the lamps, the plan of hanging the lamp over the crane in order to get a proper distribution of light without stopping the work on the crane was evolved.

Another outgrown condition of which Mr. Caird spoke was when lights were hung four in series on 220-volt circuits, each series of four covering 20,000 square feet of space; a great loss of time was entailed by the fact that if one lamp went out all went out. This brought a complaint from the foremen. As the result of this came the automatic device for cutting out lamps. When a voltage of 200 or higher is used, direct-current lamps can be equipped with an automatic cut-out and compensating resistance. Thus, if a lamp is extinguished by accident or the exhaustion of carbons, the current is automatically passed through the resistance, so that the other lamps in the series will be undisturbed. In a large shop where the loss of time of workers occupying 20,000 square feet, from even five minutes of darkness might run into hundreds of dollars the value of the device and necessity for its installation is very apparent.

Mr. Caird dwelt at some length on the value of a safety device which he had with him and exhibited to the engineers present. He said this safety device is a very important thing to the Illinois manufacturer. In that state the employers' liability act requires that extreme care be taken to avoid accidents in all manufacturing concerns. A lamp equipped with the new safety device can be handled with perfect safety, where otherwise the circuit would be grounded and the man who had the misfortune to have come in contact with the lamp might be shocked.

In reply to a question as to whether yellow or white lights are best for shop lighting Mr. Caird replied it depends on depends on the character of the work being done. The white light is best for factories where colored articles are handled, as it brings out the true color values. The yellow light is really an optical illusion, especially where opalescent globes are used. These globes, said Mr. Caird, concentrate the eye upon the ball of light and make it appear much larger and brighter than it really is but actually have the effect of cutting off about twenty per cent of the light. The clear globe is the proper one to use in factories and shops. The contention sometimes made by the men that it weakens their eyes is also an illusion, according to the speaker. He had been looking into arc lights for the past ten years and it has never affected his eyes.

The subject of blow coils was brought up by one of the members and in speaking of them Mr. Caird said that there has been some discussion as to why blow coils have been put into flaming-arc lamps. The blow coils act as regulators. When the carbon feeds down there is a rise in the current which strengthens the blow coil. An increase of the magnet-coil current lengthens the arc, decreases the voltage and keeps the current steady, which fully explains the need for blow coils for regulation purposes in flaming-arc lamps. As a fact it is impossible to get carbons that are absolutely uniform and this fact enters into the regulation. The carbon must be kept hot. Naturally as good illumination cannot be secured out of doors as in the shops, as the air enters ten degrees or more cooler outside than the temperature which is secured

indoors. The hotter the temperature of the air the better the light.

The rotary type of alternating-current lamps received some attention from Mr. Caird. Among the disadvantages of this type of lamp he pointed out that the starting load is about seventy-five per cent over normal current of ten amperes, a feature which is very disadvantageous where a large number of lamps are used on a circuit as overload necessitates the use of larger transformers and wires. These disadvantages have been overcome in recent type lamps. Mr. Caird used as an illustration the type known as the rapid-striking lamp. The lamp establishes a normal arc instantaneous thereby making the load constant. Shop lighting is figured on a basis of 5,000 square feet per direct-current lamp with yellow carbons, and 4,500 square feet for each alternating-current lamp.

### Saving Inundated Electrical Machinery.

It was first feared that the inundations which occurred in Paris last year had utterly spoiled all the electrical machinery located underground. This, however, was not the case, and in many instances it was found that a simple drying of the dynamos and motors was sufficient to put them again in working order. As soon as the machinery which had been inundated could be reached it was carefully washed, in some cases, first with slightly acidulated water, then with fresh water, and afterwards with alkaline water, with a final rinsing with fresh water. Various methods were followed for drying the different dynamos and motors and accessory apparatus and fittings. Machines should be treated immediately.

### Report on Pittsburg Traction.

The complete report prepared by B. J. Arnold on the transportation problem in Pittsburg is just being issued. A brief summary of the conclusions and recommendations is given here. The report is copiously illustrated with maps and contains much statistical information and instructive diagrams.

The report contains a general discussion of the transportation problem, with special reference to the Pittsburg district; a review of traction development in the city and of the immediate transit needs, referring also to future development; a study of the financial and operating records; and a comparison with traction results in other American cities.

The following conclusions have been made:

(1) General growth of the District is normal and healthy; (2) Population of the District relatively scattered, requiring further solidification to support rapid transit; (3) Traction District, within thirty-five years, will probably double its tributary population—to 2,000,000 people; (4) Earnings from passenger transportation will approximate $40,000,000 annually when population doubles; (5) Immediate transit needs are largely confined to surface transportation; (6) Present traction system is relatively over-expanded as compared to larger cities; (7) Service has not continuously improved to the degree to be expected. (8) Pittsburg is conspicuously low in the use of transfers; (9) Adequate service is the primary requirement, then maintenance, interest on actual investment, protection for new capital and lastly profit; (10) Fundamental defect of present system is financial—high fixed charges and failure to provide for renewals out of earnings; (11) Appraisal of property necessary to determine reasonable fixed charges and basis for adequate service; (12) Pepetual franchises inconsistent with advanced conception of public welfare; (13) City must have power to own, purchase or build transit properties on its own credit; (14) Subway development depends upon the attitude of private capital under restrictions to be imposed.

The report makes the following recommendations: (1) Legislation to provide effective State control over service, rates and capitalization; (2) Enlargement of city boundaries or creation of Metropolitan District control over transit development; (3) Legitation of property must be immediate-bonds from the debt limit of the city; (4) City Public Utility Bureau to check and record transit operations; (5) Comprehensive transit plan to be formulated and carried out under one District control; (6) General rehabilitation of property must be immediately financed without increasing present capitalization; (7) Reorganization of present traction system on a basis of fair return upon actual investment; (8) New capital to be continuously available for future extensions and betterments; (9) Establish an adequate depreciation fund out of earnings; (10) Co-operative study of re-routing, service, etc; (11) Co-operative disposition of questions pending between the city and the company regarding bridges, crossings and street improvements; (12) Publicity of company records, results and intentions; (13) Future transit program should incorporate subways, electrification of steam lines and interchange of surface and subway traffic.

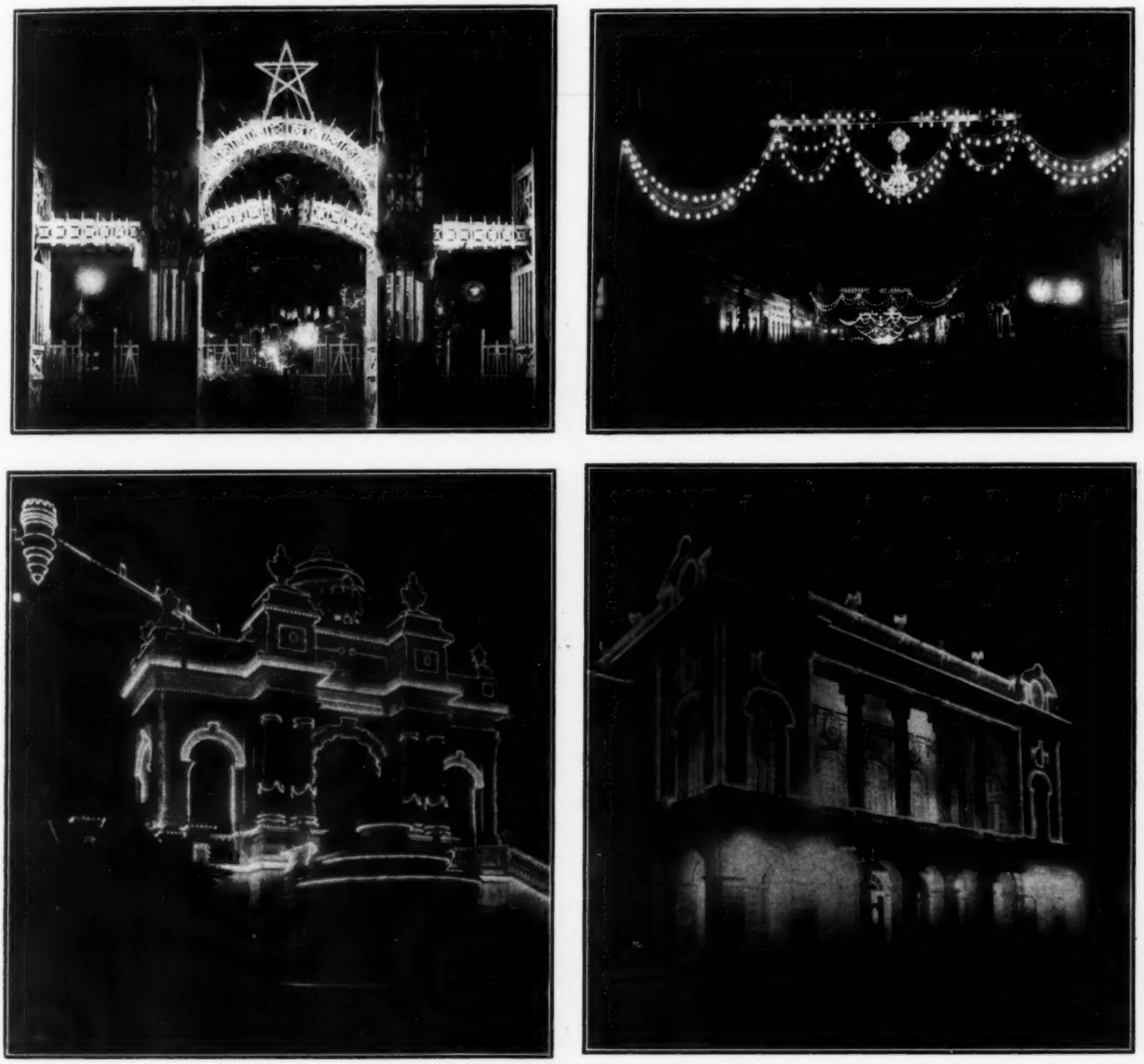
ILLUMINATION OF RAILROAD DEPOT IN SANTIAGO, CHILE.

This report was drawn up for the use of the mayor and city council in making out plans for better traction service and extensions of the existing system. Mr. Arnold was retained for this purpose about a year ago after making a preliminary survey for the Pittsburg Civic Commission.

### Festival Illumination at the Chilean Centennial.

The one hundredth anniversary of the achievement of independence and of the founding of the Republic of Chile was fittingly celebrated at Santiago, Valparaiso and other Chilean cities during the latter part of September, 1910. Although the national holiday is September 18, the festivities extended for several weeks. The marked ability of the Latin races for conducting gay and yet imposing *fiestas* was well shown on this occasion. The best of good feeling prevailed and the many foreign visitors, especially from the adjoining Argentine Republic, were accorded the warmest hospitality.

Among the numerous striking features of this festive celebration was the very fine electrical illumination of the principal public and of many private buildings. Although technical details of how this was carried out are not at hand, a good conception of it is to be had from the accompanying illustrations, which were taken in Santiago, the national capital, where most of the centenary program was carried out. The illumination at Valparaiso, while not quite so general, was also tastily done.



CENTENNIAL ILLUMINATION IN SANTIAGO, CHILE.

A $2,500,000 fund for chemical research has been given to the University of Berlin through Kaiser Wilhelm.

### Maine's Public Utilities Bill.

A bill which is under consideration in the Maine Legislature provides for a Public Utilities Commission of five to supplant the present Railroad Commission and also to have supervision over all other public service corporations, including regulation of rates. The bill is drawn on the lines of the Wisconsin law with modifications in accordance with the Ohio bill.

### Special Illumination in Minneapolis.

Special decorative and electric illumination features are to be included in the civic jubilee which is to be held in Minneapolis, Minn., July 2 to 8. The lighting is to be quite extensive.

# TELEPHONY—TELEGRAPHY, and WIRELESS.

## THE COMPARATIVE SENSITIVENESS OF SOME COMMON DETECTORS OF ELECTRICAL OSCILLATIONS.[1]

BY LOUIS W. AUSTIN.

Although probably many comparisons of the sensitiveness of detectors have been made in the laboratories of the wireless companies, very little quantitative information on this subject has been made public. For this reason the experiments here described have been carried out. On account of the difficulties and the amount of time involved in the testing of detectors in wireless stations, methods have been developed during the last three years whereby these tests can be made in the laboratory more expeditiously and accurately than is possible in the regular stations. By using properly designed exciting circuits in connection with a buzzer as a source of oscillations these difficulties have been removed. As it is also possible in this way to produce oscillations of any required degree of damping as well as of any required wave length, all of the problems of wireless telegraphy can be successfully investigated in the laboratory except those which have to do with the properties of different types of antennæ and the passage of the waves from station to station.

The exciting circuit in all the experiments is shown in Fig. 1. Here $B$ is a buzzer run by two storage cells with considerable resistance in series. The oscillatory circuit consists of a variable air condenser $C_1$ having a maximum capacity of 0.005 microfarad, and for moderate wave lengths an inductance $L_1$ of 0.062 millihenry. These are connected directly across the contact of the buzzer.

The action of the circuit is as follows: When the buzzer contact is broken, the condenser $C_1$ is charged and this charge is retained until the contact is again closed, when the condenser discharges through the contact, producing oscillations in the circuit $L_1C_1$. As these oscillations take place in a closed metallic circuit, they are very feebly damped unless extra resistance is introduced at $R$.

All buzzers are not equally suited to producing oscillations by this method. In some, considerable adjustment of the contact is required before sharp tuning is obtained. The buzzer used in these experiments was of the 1905 United States Signal Corps type, and gave very satisfactory results with wave lengths varying between 350 and 2,000 meters. With some care in adjustment the wave length could be pushed up beyond 3,000. For telephonic reception of signals it was usually found necessary to cut down the intensity of oscillations from the buzzer, and this was done by placing an incandescent lamp across the buzzer contact.

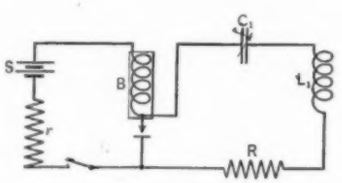



FIG. 1.

The chalcopyrite-zincite rectifier, known as the perikon detector, was used as a standard for the comparison of the various detectors. As its sensitiveness varies somewhat from time to time, it was standardized before each experiment. In all cases the results showed an admirable proportionality between the deflections of the perikon detector and the square of the oscillatory current as measured by the thermo-element.

Two general methods have been used for measuring the sensitiveness for telephonic reception of radiotelegraphic receivers: First, the shunted-telephone method in which the relative loudness of response to the same signal in two different receivers can be compared, and, second, the variable-coupling method by means of which the least audible signals for the different receivers can be compared.

A form of circuit for the shunted-telephone method in the case of the electrolytic detector is shown in Fig. 2. Here $L$ and $L'$ are wires leading to the oscillatory circuit, $K$ a stopping condenser of 0.04 microfarad capacity, $T$ the telephones, $R$ a variable resistance in shunt across the telephones, and $C$ a choke coil to prevent the oscillations from running around through $R$ instead of passing through the detector when the shunt $R$ is closed. Two sixty-ohm telephones form a suitable choke. Whatever choke coil is used it is necessary to test it by placing it across $L\ L'$. If the choke is perfect, no oscillations will pass through it, and when it is placed across $L\ L'$ no change in the loudness of the signals will be observed.

The measurement of the intensity of signal is made as follows: After the receiving circuit and detector are adjusted to give maximum loudness in the telephone the shunt resistance $R$ is closed and the resistance regulated until the signal just becomes audible. The value of the current pulses in the telephone, which are proportional to the energy of the incoming waves in the detector, is expressed in terms of the value of the shunt, the resistance of the telephones and the least current audible in the telephones. With care a series of measurements of intensity may be made to agree among themselves to within about ten per cent.

In the variable-coupling method for comparing the least audible signals in two detectors, the deflections of the galvanometer connected to the perikon are observed for a number of different degrees of coupling between the inductances $L_1$ and $L_2$. (See Fig. 3.) From these a curve is plotted which gives the variation of the received energy as determined by the distance between the coils. The coupling, for which the signals just become audible in the telephones of the detectors being compared,

1—Abstract of an article in the *Bulletin of the Bureau of Standards*, Washington, D. C., November, 1910.

is then observed and the relative energy taken from the curve.

Fig. 3 shows the general plan of the circuits used in the comparison of the detectors. *I* is the exciting circuit adjusted to send out wave trains which have a wave-group frequency and damping similar to those occurring in wireless practice. *II* is a circuit whose contacts were made to correspond to a receiving antenna of moderate size. *III* is an untuned circut containing a detector connected to a galvanometer or to a pair of head telephones, as the circumstances of the work required. The electrolytic, perikon, and audion were used in circuit *III*, each being so coupled to circuit *II* as to give maximum effect. The magnetic detector was placed in circuit *II*, as it is generally used in the antenna. The Fleming vacuum valve detector was coupled to *II* by its own fixed coupling coils.

ELECTRO AND PERIKON DETECTORS, SHUNTED-TELEPHONE METHOD.

| | Relative Sensitiveness. Strong Signals. | Weak Signals. |
|---|---|---|
| Electrolytic—Perikon ..... | 2.5 | 2.4 |
| Electrolytic—Perikon (0.2 volt).. | 1.1 | 1.3 |
| Electrolytic—Perikon ..... | 2.3 | 2.5 |
| Electrolytic—Perikon (0.2 volt).. | 1.3 | 1.3 |
| Telephone resistance 2,100 ohms. | | |
| Electrolytic—Perikon ..... | ... | 2.7 |
| Electrolytic—Perikon (0.2 volt).. | ... | 1.1 |
| Telephone resistance 813 ohms. | | |

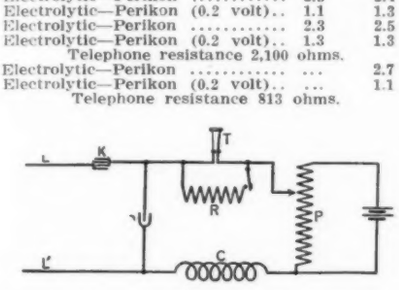



FIG. 2.

Comparison was made of the sensitiveness of the electrolytic detector and the perikon, using a wave length of approximately 900 meters and a decrement of the waves given out by the exciter circuit, amounting to 0.16. The values of the inductances and capacities of the circuits were so chosen that they simulated the conditions of commercial work.

In the above table are given the ratio of sensitiveness for both strong and weak signals. The perikon was used without external electromotive force and also with about 0.2 of a volt applied in the direction of the rectification. Comparison was made by the shunted-telephone method, the same telephones being used for both detectors. The relative sensitiveness of the two detectors was little affected by changing the resistance of the telephones, showing that their effective resistances must be about the same. It is seen that without external electromotive force the perikon is less than half as sensitive as the electrolytic, but that when the 0.2 volt is applied the difference is very small. The electrolytic used in the experiment was of the free-wire-type and two positive Wollaston wires were used during the test, one 0.003 and one 0.0012 millimeter in diameter. This was done because it has been frequently stated that the finer wire was more sensitive to weak signals. No marked difference between the two- however, could be detected. This shows that it is only necessary for sensitiveness, that the capacity reactance for the given frequency should be large, and that beyond a certain limiting diameter there is no object in reducing the size of the positive wire.

The relation between galvanometer deflections with the thermo-element in circuit *II* and the intensity of signals in the electrolytic in circuit *III*, as measured by the shunted-telephone method, shows that the responses of the electrolytic as indicated by the telephone are proportional to the square of the oscillatory current.

The circuits for the comparisons of the magnetic and perikon detectors are shown in Fig. 3. The magnetic detector was connected directly in circuit *II* since it is usually used in the antenna. The magnetic detector used was of the ordinary commercial type, the direct-current resistance of the oscillatory coil being 9.7 ohms and the telephone coil 120 ohms. The telephones furnished with the magnetic detector and used in the experiments had a resistance of 168 ohms. The telephones used with the perikon were of 1,200 ohms resistance and medium sensitiveness. For the comparison of sensitiveness the variable-coupling method was used, the coupling $L_1$ and $L_2$ being changed until the signals became inaudible. When the readings on the magnetic were being taken the circuit containing the perikon was removed, then for the perikon readings the magnetic was cut out and the coupling $L_3$ $L_4$ regulated for maximum strength of signals. The relative strength of signals for the different degrees of coupling between $L_1$ and $L_2$ was determined by means of the deflection of a galvanometer attached to the perikon. Such a series of readings is shown in the accompanying table.

RELATIVE ENERGY IN CIRCUIT *II* FOR DIFFERENT DISTANCES BETWEEN $L_1$ AND $L_2$.

| Distance in centimeters. | Perikon deflection. |
|---|---|
| 10 | 400 |
| 12 | 245 |
| 14 | 172 |
| 16 | 115 |
| 18 | 75 |
| 20 | 54 |
| 24 | 30 |
| 28 | 14 |
| 32 | 8 |
| 38 | 3 |

With waves from the buzzer circuit having a damping of 0.16 and a wave length of about 900 meters, it was found that the magnetic detector required 2.1 times as much energy to produce an audible sound as the perikon used without external electromotive force.

Further experiments showed that by putting a 0.05 microfarad condensor in series with the telephone of the magnetic, thus tuning it roughly to the rate of the buzzer, the loudness of signals could be increased so that there was very little difference between it and the perikon.

Comparisons were also made at a wave length of 350 meters and at 2,000 and 3,000 meters. At 3,000 meters the magnetic with tuned telephone was approximately one and one-half times as sensitive as the perikon. At 2,000 there was very little difference, while at 350 meters the perikon was nearly five times as sensitive as the magnetic.

In order to explain these differences in relative sensitiveness, the logarithmic

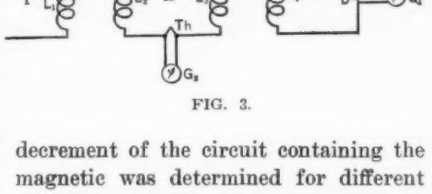



FIG. 3.

decrement of the circuit containing the magnetic was determined for different frequencies. After subtracting the known ohmic high-frequency resistance of the circuit, the other losses due to the detector for the different frequencies were shown to be as follows: For wave length 350 meters the effective resistance was 110 ohms; for 900 meters, 32 ohms; for 3,000 meters, 10 ohms. This would indicate that the amount of iron and the number of turns of the oscillatory circuits of the magnetic detector should be varied according to the frequency for which it is to be used.

RECEIVED ENERGY AND AUDIBILITY OF SIGNALS IN MAGNETIC DETECTOR.

| Perikon. Deflections in mm. | Magnetic. Telephone audibility. |
|---|---|
| 300 | 120 |
| 90 | 53 |
| 55 | 40 |
| 20.5 | 16.5 |
| 7.5 | 10 |
| 2.0 | 2 |

In the second table is shown the relation between loudness of signal as determined by the shunted-telephone

method in the magnetic and the oscillatory energy passing through it as determined by the deflections of the perikon galvanometer. It is seen that the loudness of signal in the telephone attached to the magnetic is not proportional to the square of the oscillatory current, but corresponds more nearly to the 1.4 power.

The vacuum valve detector furnished for the test was constructed with fixed coupling coils inclosed in its case, so that it was found impossible to test it fairly at any except very short wave lengths without taking it completely to pieces.

The circuits were arranged as shown in Fig. 3, the vacuum valve being coupled by its own coils to circuit *II*. Signals were taken alternately on the perikon, adjusted for maximum strength of signal, and on the vacuum detector, one detector circuit being removed when the other was in action. At a wave length of 350 meters and with a decrement of the incoming signals of 0.16, the ratio of sensitiveness of the perikon to that of the vacuum detector, as determined by the variable coupling method, was almost exactly two to one. For a wave length of 900 meters the perikon appeared to be at least ten times as sensitive as the vacuum valve. As there is no reason to believe that the vacuum detector would change its sensitiveness with frequency, this difference is almost certainly due to insufficient coupling.

In the following table is given the relation between oscillatory energy in the main circuit and the audibility of signals in the telephone of the vacuum detector, as determined by the shunted-telephone method. The audibility is seen to be proportional to the energy. The telephones furnished with the vacuum detector had a resistance of 8,300 ohms and were connected by means of a step-up transformer to the detector circuit.

RECEIVED ENERGY AND AUDIBILITY OF SIGNALS IN FLEMING VACUUM DETECTOR.

| Perikon. Deflections. | Vacuum detector. Audibility. |
|---|---|
| 43 | 38 |
| 21 | 20 |
| 10 | 9 |
| 5 | 5 |

The sensitiveness of the audion detector was compared with that of the electrolytic already described by the varying-coupling method. (See Fig. 3.) Here $L_2$ and $L_4$ were the primary and secondary of a Wireless Specialty Apparatus Company tuner, the secondary condenser of the tuner being detached. The detectors were introduced alternately in circuit *III* and their most favorable conditions of coupling were determined separately. The audion, having a higher resistance, required a stronger coupling. The same telephones (1,200 ohms) were used for both detectors, previous tests having shown that they were suited to each. High-resistance telephones up to 8,000 ohms were tried with the audion, but were found to be less satisfactory than the ones used. This is remarkable, as with the Fleming vacuum detector 8,000-ohm telephones are used and even then the current is stepped down through a transformer.

The ratio of energy sensitiveness of the audion to the electrolytic was found to be 1.5. Some of the bulbs were slightly more sensitive than this when first tried, but the sensibility decreased with use.

The law governing the relations between the intensity of the oscillations and the loudness of response in the telephone, as determined by the shunted-telephone method, seems to depend on the impressed direct electromotive force from the battery and also on the temperature of the filament, as would be expected from the known form of the current voltage curve in the case of the passage of electricity from a hot to a cold body through a gas. For most adjustments the response of the telephone is apparently nearly proportional to the square of the oscillatory current.

In addition to the above detectors, a very large number of other types have been tested in the laboratory, among which are the tellurium, silicon and carbon, and also many crystal detectors. These detectors are all of the rectifying type and are remarkable in that when properly adjusted and used with telephones of proper resistance, and in some cases with small electromotive force in the direction of the rectification, they all give practically the same sensibility as the perikon. The usefulness of several of these is, however, limited by the difficulty of adjustment and a lack of constancy. In most of these detectors the loudness of the signal increases nearly in proportion to the square of the oscillating current, although in some of them the increase in loudness is less rapid.

### Power Law in Maine.

A law has been passed in Maine providing that no corporation engaged in the transmission of power shall be granted rights of eminent domain.

### Largest Exchange in the World.

The largest telephone exchange building in the world is to be erected, at a cost of about $1,500,000, by the New York Telephone Company, following plans which are being worked out by C. L. W. Eidlitz and McKenzie, Vorhees & Gmelin.

A fifteen-story structure with foundations is to be commenced at once and the ultimate height of the building is to be twenty-five stories.

This structure, which is to be equipped with a double bank of fifteen elevators, will be used by the Company for its main long-distance switchboard, which will have 200 positions. It will provide work for 200 operators, and is to be the largest switchboard in this country. It is planned to have three boards to take care of 20,000 subscribers and provisions have been made for the handling of calls of 60,000 local subscribers when the building is complete.

### Ohio Independent Telephone Association Complains to Interstate Commerce Commission.

The Ohio Independent Telephone Association has filed a complaint with the Interstate Commerce Commission against the application of the Act to Regulate Commerce to the telephone companies operating wholly within the state of Ohio. There are about 12,000 similar companies throughout the United States and although these companies connect with toll lines they have nothing to do with the making of the toll rates. In effect the local exchange leases its lines to the long distance company.

It is contended primarily that it would work a hardship on the small companies to provide for representation in Washington.

### Higher Pay for Telegraphers.

A recent announcement made by the Commercial Telegraphers' Union states that the wages of Western Union operators working the overland circuits have been increased from $95 to $100 per month.

### Subway for Buenos Ayres.

A contract for the installation of an underground railroad has been granted to E. W. Sutphen, of New York City. The London syndicate which is behind this propositon will push the work.

# FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

## INTERBOROUGH RAPID TRANSIT.

The earnings of the Interborough Rapid Transit Company for the month of December and six months ended December 31, 1910, compares as follows:

| | 1910 | 1909 |
|---|---|---|
| Gross operating revenue.. | $ 2,760,390 | $ 2,641,052 |
| Operating expenses..... | 1,214,318 | 1,040,741 |
| Net operating revenue. | 1,546,074 | 1,600,312 |
| Taxes ..... | 156,805 | 126,276 |
| Income from operation.. | 1,389,267 | 1,474,036 |
| Other income ..... | 27,321 | 31,276 |
| Total income ..... | 1,416,588 | 1,505,313 |
| Interest, rents, etc., including Manhattan guarantee | 889,451 | 883,841 |
| Net corporation income. | 527,136 | 621,473 |
| Passengers carried ..... | 53,656,393 | 51,284,203 |
| July 1 to December 31: | | |
| Gross operating revenue.. | 14,286,689 | 13,924,809 |
| Operating expenses ..... | 5,926,562 | 5,379,808 |
| Net operating revenue.. | 8,360,126 | 8,545,001 |
| Taxes ..... | 923,475 | 833,778 |
| Income from operation.... | 7,436,650 | 7,711,222 |
| Other income ..... | 174,447 | 227,998 |
| Total income ..... | 7,611,097 | 7,939,221 |
| Interest, rent, etc., including Manhattan guarantee | 5,333,866 | 5,272,932 |
| Net corporation income. | 2,277,231 | 2,666,288 |
| Dividends (6 months)..... | 1,575,000 | 1,575,000 |
| Surplus ..... | 702,231 | 1,091,288 |
| Passengers carried .....277,186,032 | | 270,337,620 |

The increase in operating expenses is largely due to extraordinary expenditures, the result of changes in subway equipment made necessary in connection with the operations of ten-car express and six-car local trains.

## MASSACHUSETTS ELECTRIC COMPANIES.

The Massachusetts Electric Companies report for the quarter ended December 31, 1910, compared as follows:

| | 1910. | 1909. | 1908. |
|---|---|---|---|
| Gross .....$2,015,771 | $1,921,073 | $1,772,655 | |
| Expenses ..... 1,461,603 | 1,328,901 | 1,297,328 | |
| Net ..... | 554,167 | 592,172 | 475,327 |
| Charges and taxes | 456,829 | 444,654 | 432,827 |
| Surplus ..... | 97,337 | 147,518 | 42,500 |

## KINGS COUNTY ELECTRIC LIGHT & POWER COMPANY.

The combined income account of the Kings County Electric Light & Power Company and the Edison Electric Illuminating Company of Brooklyn for December and twelve months ended December 31, 1910, compares as follows:

| | 1910 | 1909 |
|---|---|---|
| December gross .....$ | 427,679 | $ 366,427 |
| Expenses ..... | 183,613 | 175,488 |
| December net ..... | 244,066 | 190,939 |
| Charges, depreciation, etc... | 123,389 | 102,900 |
| Surplus ..... | 120,677 | 88,039 |
| Twelve months' gross..... | 4,333,354 | 3,733,840 |
| Expenses ..... | 2,054,921 | 1,834,130 |
| Twelve months' net..... | 2,278,433 | 1,899,710 |
| Charges, depreciation, etc... | 1,287,420 | 1,079,533 |
| Surplus ..... | 991,013 | 820,177 |

## NORFOLK & PORTSMOUTH TRACTION.

The report of the Norfolk & Portsmouth Traction Company for the month of December and six months ended December 31, 1910, compares as follows:

| | 1910 | 1909 |
|---|---|---|
| December gross .....$ | 179,111 | $ 163,444 |
| Expenses ..... | 94,878 | 95,394 |
| December net ..... | 84,233 | 68,050 |
| Six months gross..... | 1,079,823 | 988,411 |
| Expenses ..... | 598,059 | 554,735 |
| Six months net..... | 481,764 | 433,676 |

## PHILADELPHIA COMPANY.

The Philadelphia Company reports to the New York Stock Exchange for the eight months ended November 30, 1910, compares as follows:

| | 1910. | 1909. |
|---|---|---|
| Gross earnings, all sources. | $3,635,340 | 3,535,547 |
| Operating exp. and taxes.. | 1,544,769 | 1,683,326 |
| Net earnings ..... | 2,090,570 | 1,852,221 |
| Other income ..... | 1,506,676 | 1,398,670 |
| Total income ..... | 3,597,247 | 3,250,892 |
| Fixed charges ..... | 846,022 | 867,612 |
| Balance ..... | 2,751,225 | 2,383,279 |
| Improvements, betterments and extensions ..... | 1,180,691 | 584,728 |
| Surplus ..... | 1,570,535 | 1,798,551 |
| Previous surplus ..... | 4,610,779 | 3,336,696 |
| Total surplus ..... | 6,181,314 | 5,135,247 |
| Dividends, discounts on securities, etc. ..... | 1,780,809 | 1,508,863 |
| Profit and loss surplus Nov. 30 ..... | 4,400,504 | 3,626,384 |

## SOUTH SIDE ELEVATED.

The South Side Elevated Railroad Company reports for the year ended December 31, 1910, compared as follows:

| | 1910. | 1909. |
|---|---|---|
| Passenger .....$ | 2,343,782 | $2,136,131 |
| Advertising and miscellaneous ..... | 113,706 | 98,840 |
| Total gross ..... | 2,457,488 | 2,234,971 |
| Maintenance of way ..... | 130,277 | 126,574 |
| Maintenance of equipment. | 161,789 | 156,150 |
| Cond. transportation..... | 818,379 | 746,575 |
| Loop rent expenses..... | 315,778 | 281,599 |
| General ..... | 227,287 | 213,004 |
| Total expenses ..... | 1,653,511 | 1,523,954 |
| Net earnings ..... | 803,977 | 711,018 |
| Interest and rent..... | 453,080 | 453,080 |
| Surplus ..... | *350,897 | 257,938 |
| Dividends ..... | 153,447 | ..... |
| Surplus ..... | 197,449 | 257,938 |

*Equal to 3.4 per cent on $10,328,800 capital stock as against 2.49 per cent earned on same stock previous year.

## NEW YORK TRACTIONS.

The Public Service Commission has issued the following statement showing the earnings of the principal New York traction lines for the month of October as follows:

| | Total st. ry. oper. rev. | Net. rev. from oper. | Total income. | ‡Surplus after Charges. |
|---|---|---|---|---|
| Hud & Man | $226,908 | $120,652 | $194,033 | $1,945 |
| Interboro: | | | | |
| Subway .. | 1,210,956 | 724,483 | 1,440,762 | 535,950 |
| Elevated .. | 1,336,697 | 686,729 | | |
| B R T syst. | 1,843,006 | 677,868 | 716,117 | 191,842 |
| †Metrop. St. | 1,208,758 | 400,428 | 415,715 | 198,438 |
| C Pk N & E | 55,508 | 4,504 | 4,504 | 3,564 |
| †Second Av. | 78,565 | 10,202 | 10,203 | 897 |
| †Third Av.. | 291,330 | 119,363 | 119,363 | 85,242 |
| †Dry Dock.. | 51,089 | 11,224 | 11,224 | 1,684 |
| †42nd St. M. | 133,840 | 38,100 | 38,100 | 26,974 |
| N. Y. C. Int | 22,751 | 4,706 | 4,840 | *3,079 |
| †Union ..... | 190,313 | 49,010 | 49,022 | 30,920 |
| †Westch'ter. | 45,557 | 9,038 | 9,146 | 5,771 |
| †Yonkers RR | 57,663 | 4,835 | 4,835 | 4,523 |
| N Y&Q Co. | 99,152 | *15,556 | *15,799 | *36,772 |
| Coney I.& B. | 114,931 | 32,178 | 32,186 | 8,300 |

*Deficit. †Operated by receivers. ‡Interest permanently defaulted is not deducted.

## UNITED RAILWAYS OF ST. LOUIS.

The United Railways of St. Louis report for the year ended December 31, 1910, compared as follows:

| | 1910. | 1909. |
|---|---|---|
| Gross .....$ | 11,537,774 | $11,111,431 |
| Expenses, taxes and depreciation ..... | 7,906,103 | 7,028,178 |
| Net ..... | 3,631,671 | 4,083,253 |
| Other increases ..... | 43,067 | ..... |
| Total increase..... | 3,674,738 | 4,083,253 |
| Charges ..... | 2,793,743 | 2,798,182 |
| Balance ..... | *880,995 | 1,285,071 |
| Preferred dividends..... | 409,580 | 849,160 |
| Surplus ..... | 471,415 | 435,911 |

*Equal to 5.2 per cent on $16,983,200 preferred stock, which does not include $3,000,000 preferred stock held in treasury of company. This compares with 7.57 per cent earned on same stock previous year.

## NIAGARA FALLS POWER.

The Niagara Falls Power Company has issued its pamphlet report for the year ended December 31, 1910. The combined income account of the Niagara Falls Power Company and Canadian Niagara Power Company shows a surplus after fixed charges of $665,061, equal to 15.83 per cent on the $4,200,000 outstanding capital stock, as compared with 10.82 per cent earned on the same stock the previous year. Following are the figures:

| | 1910 | 1909 |
|---|---|---|
| Gross .....$ | 2,203,134 | $1,952,348 |
| *Expense ..... | 438,733 | 431,297 |
| Net .....$ | 1,764,400 | $1,521,051 |
| Other income ..... | 152,505 | 134,078 |
| Total income .....$ | 1,916,906 | $1,655,129 |
| Fixed charges, etc..... | 1,251,845 | 1,200,635 |
| Surplus .....$ | 665,061 | $ 454,494 |

* Includes $100,000 charged in respect of obsolescence and a reserve against extraordinary casualties.

## COLUMBUS RAILWAY COMPANY.

At the annual meeting of the Columbus Railway & Light Company the report for the fiscal year ended December 31, 1910, was presented, showing a deficit, after dividends, of $353,146, which reduced the total surplus to $36,032. In his report to stockholders President Robert E. Sheldon says: "By reason of a strike, the year's results have not been as satisfactory as we could wish. I am pleased to report, however, that our business again is normal, and there is every reason to expect a satisfactory year. All obligations for rentals have been fully paid, and the usual charges on account of appreciation have been met."

## JACKSONVILLE ELECTRIC COMPANY.

The Jacksonville Electric Company, a Stone & Webster property, reports earnings for the year 1910 as follows: Gross, $576,081, an increase of $89,304 over the previous year; net $264,843, an increase of $47,261. The balance after charges was $164,345, an increase of $46,650; and the surplus after dividends was $69,845.

## MONTREAL STREET RAILWAY.

The report of the Montreal Street Railway Company, for the month of December and three months ended December 31, compares as follows:

| | 1910 | 1909 |
|---|---|---|
| December gross .....$ | 377,274 | $ 337,563 |
| Expenses ..... | 235,209 | 212,006 |
| December net ..... | 142,065 | 125,556 |
| Charges and taxes..... | 37,642 | 34,480 |
| December surplus ..... | 104,423 | 91,076 |
| Six months' gross..... | 1,130,060 | 1,026,441 |
| Expenses ..... | 668,401 | 586,879 |
| Three months' net..... | 461,659 | 439,562 |
| Charges and taxes..... | 101,653 | 96,345 |
| Three months' surplus.... | 360,006 | 343,217 |

# New Electrical and Mechanical Apparatus and Appliances.

### Connecticut Synchronous Signal Igniter.

Among new things in the ignition line attracting attention was the synchronous signal igniter exhibited by the Connecticut Telephone & Electric Company, Meriden, Conn., at the New York Electric Show. This combines all the essentials of an absolutely high-grade reliable ignition system for automobiles or motor boats which may be used independently or as an auxiliary to a magneto. It comprises a combined circuit-breaker and secondary distributor, a transformer coil with starting vibrator and signal lamp, and a steering-wheel switch or combination battery and magneto switch.

The circuit-breaker and distributor is designed for operation from the cam shaft. The driving shaft, which is provided with a hole for attaching to engine shaft, revolves on imported ball bearings and the cam for actuating the circuit-breaker is composed of hard steel pins set lengthwise equidistant into this shaft which upon revolving strike the roller of the breaker arm in succession, thereby making and breaking the circuit successively. The breaker mechanism is very simple and effective. It is composed of a very light steel lever pivoted upon a steel stud and provided with a bone fiber roller and a large platinum-iridium contact which is held against an adjustable platinum-iridium contact screw by a steel spring.

The distributor arm is fastened by sliding key to the shaft and contact with the distributor blocks and coil terminals is made by carbon brushes. The cap forming the upper part of the apparatus is composed of a highly insulating material, far superior to hard rubber, and the bronze contact blocks are molded in this cap and are provided with terminals for connection to the spark plugs and transformer coil. The instrument is made of the best materials, of the finest workmanship, and superior in design to anything on the market.

The transformer coil supplied with this outfit is designed to be mounted under the bonnet and is made to withstand a high degree of heat. It is contained in a hard fiber tube and fastened on the dash of a brass mounting. It is dirt and waterproof and all terminals are on the outside, easily accessible. A tube containing the vibrator starting button projects through the dash. This tube also contains the signal lamp which indicates when the switch is turned on. This lamp will remain lighted until the switch is turned off.

### New Vertical Radiant Toaster.

The electric toaster is, perhaps, the most popular of the various electrical cooking devices now available. It is one of those remarkable articles, which so completely satisfies all the requirements of real convenience and utility,

SYNCHRONOUS SIGNAL IGNITER.

that it is rapidly attaining the character of a modern household necessity wherever electric current is available for domestic use.

When the General Electric Company brought out its first vertical type of toaster, its advantages were so apparent that it received quick recognition as ideal in its line. This appreciation was well merited because the new design enabled the making of two slices of toast simultaneously, greatly reducing the time and cost, and increasing the convenience of preparing the favorite breakfast dainty.

The vertical type of toaster not only represented a marked advance in the direction of increased utility, but served to establish the value of "Calorite" as a resistance material for producing intense radiant heat under the influence of an electric current. As in the case of tungsten, tantalum and other metals used as efficient light givers, the history of "Calorite," the new metal used as an efficient heat giver, is too familiar to bear repetition.

The 1911 model of the General Electric Company's vertical radiant toaster embodies new features, very commendable to prospective users of such devices. The inclined rack has been substituted for the perpendicular holder of the earlier design for increasing the convenience of the toaster. The slices of toast are thus rendered more accessible, and can be turned around more readily during the process of toasting.

The individual contact plugs adopted for the ornamental electric heating and cooking devices are applied to the new toaster. The plugs are incased in polished nickel cylinders, which add to the attractiveness of the toaster and place it in harmony with its companions on the buffet.

### Life of Underground Cables.

Although in their early days grave doubts were raised as to the reliability of underground cables, especially by those who were compelled unwillingly to make the necessary financial investment, the reliability of such cables is now well understood. Nevertheless, except to establish the fact that such cables have at least a reasonably long life, not very much data has been accumulated to show just what the probable upper limit of life may be. This is due to the fact that cables carefully installed in accordance with the present practice have not only given satisfactory account of themselves to date, but show no indication that they will not continue to do so for sometime to come.

A report of the special telephone commission appointed by the City of Chicago to investigate the telephone situation in that city, issued April, 1907, shows an estimated life of underground telephone cable of twenty years for main conductors and fifteen years for subsidiary conductors. There are, however, instances of power cables which have been operating this length of time and which as yet show no signs of deterioration, indicating that

they will yet continue to successfully operate for a long time to come.

A cable was removed from the ducts of the city of Philadelphia September 22, 1910, due to a change in the arrangement of circuits necessitating the withdrawal of this particular cable. This cable was installed in Broad Street, Philadelphia, running from Chestnut and Broad Streets south to Washington and Broad Streets, during the month of May, 1886, having been manufactured in April, 1886, by the Standard Underground Cable Company. It had therefore been in operation continuously for over twenty-four years, and even at the present time shows absolutely no indication of deterioration in any way, notwithstanding the fact that while the cable was sold to operate under a working pressure of 600 volts, the circuit had for years been used for 2,000 volts arc-light service.

The makeup of the cable is of some interest, due to the fact that the insulation is of a saturated fibre, a type that, due to the increasing demands for higher voltage, has been largely superseded. The cable in question is a No. 4 B. & S. gauge stranded conductor made up of sixteen No. 16 B. & S. gauge wires.

### Railway Telephone System on Chesapeake & Ohio.

From Fortress Monroe all the way to Cincinnati, Ohio, a distance of nearly 1,000 miles, the Chesapeake & Ohio Railroad will soon be using the telephone method of controlling train movements. Since last March the telegraph has been supplanted for train dispatching over four of the most important divisions of this road. Two new divisions were recently equipped with telephones and have rendered service since December 24.

The telephone system now in use comprises 545 miles with 154 way stations. When present plans are completed nine divisions will be equipped, with 992 miles and 248 telephone way stations.

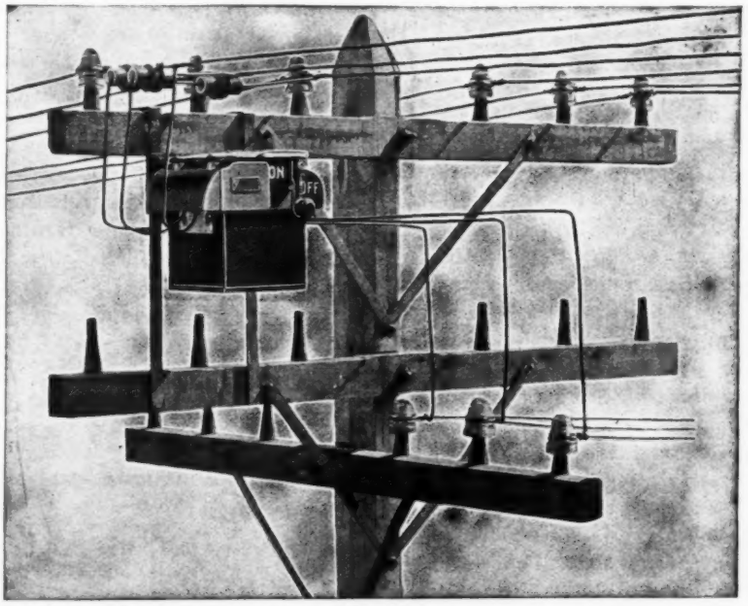
The new equipment will be installed on the main line between Clifton Forge and Charlottesville, between Charlottesville and Richmond and between Richmond and Fortress Monroe. The telephone and installing material is being furnished by the Western Electric Company.

### New Oil-Break Pole-Line Switch.

Owing to the magnitude and complexity of the electrical distribution systems of the present day, it is very important in many cases that means be provided for cutting portions of the circuit in or out of service by suitable devices installed at points which necessarily must be remote from the station. Such a device must be designed for installation out of doors and for operation under load, and would find application in sectionalizing feeder systems, cutting in and out transformers, and in similar service. In many cases the use of this switch in connection with a transformer will obviate the necessity of bringing high-tension lines into the building.

To meet this demand the General Electric Company has designed an oil-break switch which is simple, introduces no complications in wiring, and, on account of the very convenient construction of the frame and method of supporting, is very easily installed. It can be mounted on a flat surface or, by use of strap iron hooks, on transmission pole cross arms in a manner similar to that usually employed for mounting pole-type transformers.

This pole-line oil-break switch is thoroughly weatherproof. It is entirely inclosed in a cast-iron frame, fitted with a removable cover, grooved on the under side to fit closely to the edge of the frame and supplied with a suitable gasket which prevents damage to the mechanism due to weather conditions. A detachable oil vessel, with insulating line and barriers between the switch poles, fits around a flange at the bottom of the frame. The stationary contacts are flared fingers of drop-forged copper, supported from the contact blocks of the copper current-carrying studs, by a heavy flat steel frame. The studs are supported by and insulated from the frame by porcelain insulators. The movable contacts are wedge-shaped copper blades hinged at one end. They are actuated by specially treated wooden rods connected to the shaft which in turn is operated by the crank and handle outside of the frame. The construction of the stationary and movable contacts is such that any burning, due to rupturing the arc, is confined to the tips of the stationary contact fingers and the upper extremity of the movable contacts, preserving the actual current carrying surfaces. This feature of construction insures clean contact surface and uniform contact pressure.




INSTALLATION OF OIL-BREAK POLE-LINE SWITCH.

This switch is built in sizes up to 200 amperes at 15,000 volts. The method of bringing the leads to the switch varies somewhat according to the voltage, but in every case they enter through porcelain bushings protected from the weather by the overhang of the frame. The switches up to 4,500 volts are designed for use with insulated wire, while for voltages between 4,500 and 15,000 bushings are furnished which allow the use of bare wire.

### Miscellaneous Installations of Girod Electric Furnaces.

At one plant in Ugine, France, six Girod electric furnaces are now in operation; two of these furnaces are each refining up to sixteen tons of cold charges of ordinary scrap material, and recently, in the presence of the Controller of the French Navy, one of these furnaces made a heat of eighteen tons of steel for castings. These furnaces are operated exclusively with cold charges; but if molten charges were used, they could easily receive charges of twenty tons. They are supplied with 1,200 to 1,500 kilowatts, and each are provided with four electrodes.

Two other furnaces at this same plant with a capacity of three tons of cold or four tons of molten charges are operated each with a single electrode. The power capacity of these furnaces is about 325 to 350 kilowatts.

Two furnaces each having a capacity of two tons are also in operation at this works, and the output of the works consists of high-grade tool steels, projectile steel, and steel for castings, automobiles, etc.

A new 8,000-kilowatt power furnace is now being installed at this works, and the Girod Company also has forty other furnaces operating exclusively on ferro alloys.

The Cockerill Company in Seraing, Belgium, has been operating a four to five-ton Girod furnace for the past two years, and is refining molten Thomas steel for rails, locomotive tires, cannons, automobiles, etc., and the well known German firm of Krupp & Company is now installing a 12.5 ton Girod furnace to be operated with three-phase current, and shall use it for the production of tool steel, castings, cannons, automobiles and other Krupp product.

The Girod furnace installed by the Simonds Manufacturing Company at Chicago is being transferred to its new and modern plant at Lockport, N. Y., and shall be used for refining the high grade of steel required for their saws, machine knives, files, etc.

### A New Electric Timepiece for London.

A firm of electric contractors in London, Eng., has installed, as an advertisement, an electrically driven time ball which drops every hour. This is said to be the most reliable public timepiece in London.

## NEW WESTERN ELECTRIC APPARATUS.

PORTABLE ELECTRIC BREAST DRILL.

A new line of Western Electric Hawthorn portable electric drills has just been placed on the market. These drills combine compactness and durability of construction with safe and reliable operation. They are made for

PORTABLE BREAST DRILL.

use on 110 or 220-volt direct-current, and sixty-cycle, single-phase, alternating-current circuits, an Edison socket and cord being supplied so the drill can be operated from any standard lamp socket or screw-base receptacle. The motor is incased in a dust-proof case and all electrical parts are well insulated and protected, insuring freedom from shocks. The frame is of black japan, with nickel-plated trimmings, and an aluminum breastplate or spade handle can be had, as desired. Small oil chambers, so placed as to prevent leakage when the drill is being used, insure good lubrication for all moving parts.

The motor, weighing about twenty pounds, is supplied with two knurled side handles and the controlling switch is conveniently located within easy reach of the right hand grasping the handle, which allows the operator full control of drill. A Jacobs clutch, which takes drills up to and including three-eighths of an inch in diameter, and the necessary tightening key are furnished.

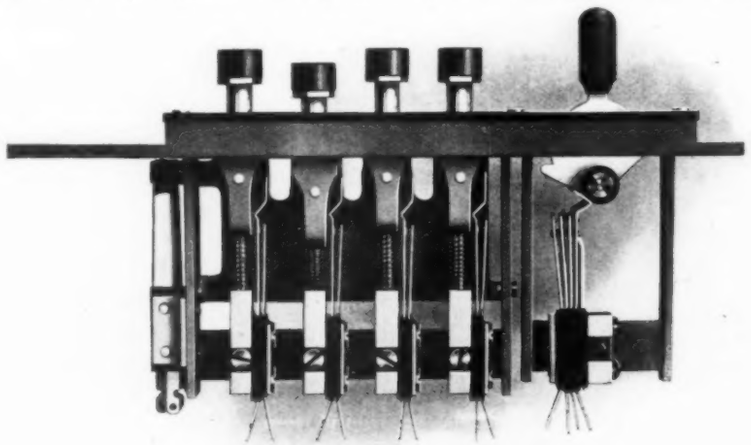
NEW HARMONIC RINGING KEY.

A new type of key designed especially for harmonic ringing and embodying many new features of merit, as well as many features which will be recognized as those found in their horizontal type of key now so extensively used, has been placed on the market by the Western Electric Company.

This key, known as the No. 468 type, is of the locking-indicating type. After ringing the subscriber, the button remains in an intermediate position between fully depressed and normal, thus indicating the last party rung.

The key has a heavy cast-brass frame covered with a rubber escutcheon, which mounts flush with the key-shelf. Machine screws are used to fasten the key to the iron framework of the key-shelf.

A distinctive feature is the fact that each group of springs is mounted as a unit. All units are alike and, therefore, interchangeable. They may be removed by simply taking out one screw. In this type of key there is only one pair of talking contacts. The plungers are of the roller type and absolutely noiseless in operation.



KEY FOR FOUR-PARTY HARMONIC RINGING.

A TESTING CABINET FOR THE SMALL TELEPHONE SWITCHBOARD.

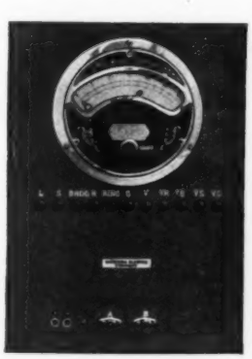
To meet the demand for an inexpensive testing outfit for small telephone exchanges, where a reliable means of testing is absolutely essential but where the outlay for an elaborate wire

chief's equipment seems prohibitive, the Western Electric Company has placed on the market a new testing cabinet.

This cabinet, known as the No. 1407, can be used with any switchboard and will do practically the same work as the large and expensive wire chief's desks. It is made in two styles, one for use with magneto switchboards and the other with the common-battery switchboards. The cabinet is adapted to be fastened to the end of a regular switchboard, or elsewhere, as desired. The voltmeter is mounted on the front of a substantially made oak case, directly above the switching keys. The two terminals for connection to a Wheatstone bridge and the terminals for the grounding and testing cords are arranged at the bottom.

The apparatus consists of a testing circuit, an operator's circuit, a ringing circuit with keys and a grounding cord with flexible cord and plug. Both the testing circuit and grounding cord terminate on eight-foot cords, and are equipped with No. 47 cord plugs.

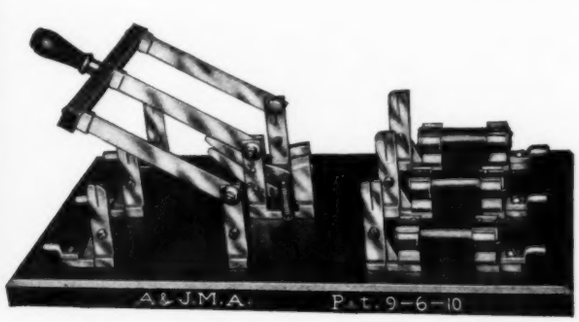
Some of the tests which can be made with this testing cabinet are grounds, opens, shorts and partial shorts, etc.



TESTING CABINET.

### Induction-Motor Starting Switch.

The motor-starting switch illustrated herewith was designed to secure better protection of motor and starting compensator than has been possible heretofore, without the use of a very complicated mechanism.




INDUCTION-MOTOR STARTING SWITCH.

The first and most important advantage obtained is the prevention of connecting in the motor to the full voltage supply without first connecting it to the compensator. This is accomplished in an unfailing and positive manner by the blade stop, which allows the switch to be thrown to a running position, only after it has first been into the compensator side.

Another important safe-guarding feature is that the switch will only remain in the compensator clips so long as it is held there by hand; two powerful springs being used in such a manner that on releasing the handle, the switch immediately flies open. This feature is considered very important, as a careless operator is liable to leave the switch as soon as he sees the motor running, without throwing it over to the running side, which would result in the burning out of the compensator.

The designers and manufacturers of this switch, Albert & J. M. Anderson Manufacturing Company, are prepared to furnish switches of this type in the following capacities:—25, 50, 75, 100 and 150 amperes.

WESTINGHOUSE LONG-SCALE SWITCHBOARD METER.

### Long-Scale Switchboard Meters.

A meter with readings easily legible, for use in large installations where this characteristic is essential, requires a long and well illuminated scale. The long scale has been obtained by meter manufacturers in two ways. The simplest and most obvious way is to extend the pointer and the radius of the scale of a short scale meter until the desired length of scale is obtained. The other method of obtaining a long scale is to increase the arc subtended by the scale. a method involving a completely new design of meter.

It was this second method which was adopted by the Westinghouse Electric & Manufacturing Company in placing on the market its complete line of type F alternating-current switchboard meters. These are round pattern meters of the usual size, about nine and one-half inches in diameter, with scales subtending an arc of 300 degrees and about fourteen and one-half inches long. The length of scale usually found only in the large illuminated-dial meters is thus obtained in a meter of normal size. There is no metal front on the meter but instead a round glass cover is used. This makes it possible to thoroughly illuminate the dial from the front and thus avoid the use of special lamps.

The meters operate on the induction principle. The torque depends on the section of a rotating magnetic field on a light, pivoted drum. This principle makes connections to the moving element unnecessary, and, by avoiding the use of a copper coil or iron core for the moving part, reduces the weight on the pivot bearings and consequently the friction. This leads to accuracy and long life. The moving element also has inherent damping qualities, and the torque developed is very high. The controlling springs, which balance the torque, are made of a special alloy, tempered and aged to insure permanence under all conditions.

The type F meters are furnished as ammeters, voltmeters, single-phase and polyphase watt-meters, power-factor meters, and direct-reading frequency meters. All of these meters utilize different forms of the induction principle.

### National Carbon Company's Salesmen Hold Convention.

The fifth annual salesmen's convention of the National Carbon Company of Cleveland, O., was recently held. They report this to be the most interesting and progressive convention they have ever held.

Each day practical demonstrations and tests were made with various types

of lamps to show the kind of service that their various carbons would give in these lamps. The carbon that was given particular attention during these demonstrations was the yellow flaming carbon, known as Silvertip. It was burned in practically every known type of lamp under a wide variety of service conditions and gave satisfaction generally.

During the discussions that followed the demonstrations the salesmen from various parts of the United States told of the universal satisfaction that this carbon is giving in the field.

They say that the mechanical feature of the silver tip is a very strong factor in making this so universally popular. This silver tip does away with the loose end of the core wire and makes a firm electrical contact in the holder. There are no broken wires, therefore no lost carbons. Trimmers' time is saved and operating expenses are reduced.

The salesmen were enthusiastic in their prediction about the ultimate universal use of this carbon in flaming lamps.

### Silver Plating on German Silver.

In a paper read before the Institute of Metals in London last month, A. McWilliam and W. R. Barclay presented a paper dealing with the adhesion of silver to a base metal when electrolytically deposited. Such plated ware receives very severe treatment and troubles are frequently experienced owing to the silver coating becoming broken and stripping from its base, particularly when the deposits are thick. As German silver is the alloy generally used as the base metal, various compositions of this alloy were tried by the authors and it was found that the plate adhered most firmly to the lowest grades and stripped most easily from the alloys with high nickel content. All things considered, the grade known as thirds was found to give the best results.

### Railway Equipment for Chicago.

The General Electric Company has taken what is said to be the largest order for street railway apparatus ever received by an electrical concern. The order calls for 1,000 car equipments for the Chicago City Railways and totals very close to $2,000,000 in cost.

### Telephone Installation in Brazil.

Among the many common-battery exchange systems installed recently by the Kellogg Switchboard & Supply Company, the eleven-section 10,000-line capacity exchange for Sau Paulo, Brazil, is of special interest on account of its size and importance.

This system is to be used first as a

CHIEF OPERATOR'S DESK.

magneto multiple lamp-signal switchboard, but is so designed that it may be changed to a common-battery system without discarding any of the original apparatus. The present equipment is 4,960 lines.

This massive quartered-oak board, illustrated herewith from photograph taken just previous to packing, will be equipped for thirty-one operators' positions, each to have fifteen universal cords with ring-back keys.

WIRE CHIEF'S DESK.

The Kellogg Company has furnished a complete accessory apparatus, including intermediate distributing frame, terminal clips, for 4,960 lines on answering and multiple side. The relay frame is for 5,400 subscribers' lines.

The Kellogg main distributing frame is equipped with 4,960 Kellogg arresters and terminal clips for 6,250 outside lines. There is to be one two-position chief-operator's desk and one one-position wire-chief's desk.

The complete operating plant will be made up as follows: One set of eleven storage battery, two motor-generator charging sets operated from 220 volts; sixty-cycles; three-phase alternating current. Two ringing machines with howler attachment, one to operate from the battery and the other to operate from the primary-battery circuit. One white Italian marble power switchboard.

The slight change in the wiring at the relay rack is all that is necessary to convert a magneto line to a common-battery line. The cord circuits as furnished are of the universal type and will automatically adapt themselves to line conditions.

SWITCHBOARD FOR BRAZILIAN EXCHANGE.

### Central Electric Company's Annual Reception and Dance.

On Thursday evening, January 12, the Central Electric Company, of Chicago, held its third annual reception and dance, at the club house of the West End Woman's Club.

About 150 couples composed of employees of the Company and their friends enjoyed an extremely pleasant evening. The music, which was furnished by Pierce's Orchestra, was excellent and an elaborate supper was served during the intermission.

The evening was rendered most pleasant by the presence of President and Mrs. George. A. Kinlock, and the many outside salesmen who were in town for the semi-annual sales conference of the Company. No formal addresses were made.

# Electric Vehicles—1911 Models.

The issuance of this electric-vehicle supplement is coincident with the annual Chicago Automobile Show and no more convincing evidence of the present status of the electrically propelled vehicle is necessary than is indicated by the comprehensiveness of the exhibits maintained by the various manufacturers.

No radical departures from previous designs are announced for 1911. The electric-vehicle industry is, however, gaining a stronger foothold and the design of the cars, both pleasure and commercial, has a decided tendency towards standardization along general lines. In pleasure cars, the coupé, being as it is an all-year-round vehicle, continues to be the most popular. The 1911 models as a general rule, are perhaps slightly larger and roomier than heretofore and the appointments leave nothing to be desired.

In recent months the Edison nickel-steel battery has come into practical use and has had its influence upon the design and construction of the latest models—an influence destined no doubt to increase with time. Of greater bulk and lighter weight than the lead battery, it has developed quite phenomenal mileage, and also has long life.

Another new battery which has recently been introduced and which will have an effect on electric-vehicle development, is the Ironclad-Exide battery. The positive plate of this battery is said to have a greater capacity per unit weight than the Exide plates. The negative plate is of the same general construction as the standard Exide negative, but is made somewhat thicker to withstand the longer life of the positive plate.

For the purpose of obtaining a maximum distance on a single charge, thus necessitating larger cells, many of the new models of pleasure vehicles conform very closely to the general outlines of the gasoline roadsters, thus allowing about three-fourths of the battery to be placed in the front and only one-fourth in the rear of the car, and at the same time combining many of the advantages of the gasoline car with those of the electric, and making the car thoroughly a man's car.

In the business progress of commercial vehicles the year 1910 has witnessed a distinct advance. The design of 1911 commercial vehicles indicates that recognition is already given to the importance of electric commercial vehicles as the most efficient and economical solution of the problems of city hauling. The most up-to-date business concerns are interested in the investigation of their costs of teaming and are aiming to introduce the more economical methods of electric commercial trucks and delivery-wagon service. The models presented for 1911 are designed for every class of service—from hauling coal to small packages.

The following series of descriptions are of the 1911 models of a number of the leading manufacturers:

BABCOCK ELECTRIC CARRIAGE COMPANY.

A general improvement in the foot-control device applied to the Babcock electric vehicles and general refinement in the design of its eight standard models is announced by the Babcock Electric Carriage Company.

The Babcock foot control is claimed by the Company to be the surest and simplest device for starting, stopping or regulating the speed of a motor car. Power is supplied and different speeds obtained through a hand controller at the left of the operator. This controller gives five speeds forward and one reverse. At the left of the steering column on the footboard is a pedal which applies a powerful double-acting band brake, and controls the power independently of the controller. It graduates each one of the five speeds three times, so that the range is increased from five to fifteen speeds.

All Babcock models are regularly equipped with high-capacity batteries, manufactured by the Philadelphia Storage Battery Company. All models can be equipped with Edison batteries if desired.

The chassis of the Babcock car is constructed of armored wood. The irreversible steering wheel is a feature of each model, although the lever will be substituted where desired. The double-chain drive is adhered to in all Babcock models. In the 1911 models these chains are inclosed in a dust and oil-proof case. All fenders are completely inclosed, so that the long running-board steps are always free from mud and dirt.

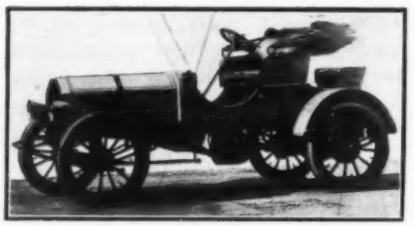
In the accompanying illustrations are shown a four-passenger brougham and a model 12 Babcock roadster. The former is a luxurious, roomy car, containing special revolving front seats, which permits the occupants to face forward, sideways or backward. When not in use these seats can be removed. The gen-

BABCOCK BROUGHAM.

BABCOCK ROADSTER.

eral specifications for this model are: Wheels, 32 by 4 inches, Tinkem bearings; tires, 32 by 4 inches, Goodyear quick-detachable; motor, of special design capable of developing fifteen horsepower; control, five speeds forward, one reverse; speed, from two to twenty-three miles per hour; brakes, duplex countershaft, internal expansion in rear wheels; drive, double chain; wheel base, eighty-six inches; battery, thirty-six cells, "Philadelphia" battery or Edison battery.

The specifications of the roadster differ from the brougham on the following points: The motor will develop twenty horsepower, the speed ranges from two to thirty-five miles per hour, the wheel base is ninety-four inches and the car is equipped with forty-two cells "Philadelphia" battery. This model can also be equipped with Edison batteries if desired.



BAKER ROADSTER.

The transmission from the motor to the countershaft is by Reynold silent chain, inclosed in a dust and oil-proof case. The Reynolds chain is self-adjusting as to pitch. Transmission from countershaft to the rear axle is by Baker bevel-gear drive. Differentiating gears are mounted on three-arm member with provision for self-alining movement. All gears are inclosed. The transmission shaft drives in a straight line and has two universal joints, allowing free movement of the rear springs.

The motor is of special four-pole design, series wound, with large commutators. The motor is said not to spark under the heaviest loads. It is attached to the frame by the new three-point suspension system.

The controller is of the continuous-torque drum type, giving speed changes without arcing or fusing. It provides for six speeds forward and three reverse on one lever. The controller has a special mechanical lock which does away with the electrical plugs and makes it absolutely impossible to start the car except by the use of the owner's key.

The Baker electric is equipped with two sets of internal expanding brakes on the rear wheels. Both breaks are mechanical, and are operated by foot levers with steel-rod connections. There are equalizing bars in each brake to insure the same braking power on each wheel.

The extension coupé shown in one of the accompanying illustrations has seating capacity for four, and may be interchanged with a victoria body. The runabout model is designed for the business man who wants more speed and mileage than the ordinary electric affords. The roadster model, shown herewith, is claimed to be the fastest electric vehicle manufactured. The controller lever is placed on the steering wheel and is capable of giving eleven speeds forward. The speed of this car is from three to thirty miles per hour. It is equipped with a forty-cell battery.

BAKER COUPÉ.

BAKER EXTENSION COUPÉ.

BAKER RUNABOUT.

BAKER MOTOR VEHICLE COMPANY.

The Baker Motor Vehicle Company, Cleveland O., in furtherance of its policy established some time ago, is constructing all of its cars for the bevel-gear shaft drive. A number of refinements of design are apparent in the models for 1911.

The rear axle of the 1911 model is of the semi-floating type of latest design. It is made of vanadium alloy steel and is housed in a sheet-steel casing. The hub of the front axle is drawn from sheet steel. The spring seats are machined and the tubing is of special steel with semi-spring temper. The yokes are attached to the tubing by the electric welding process.

BROC ELECTRIC VEHICLE COMPANY.

Three Broc electric vehicles, 1911 model, have been subject to extensive improvements. The roadster is known as model 19, the stanhope as model 20 and four-passenger coupé as model 24. The specifications for the roadster are: Wheel base, eighty-three inches; tires, 32 by 3.5-inch pneumatic; speed, 4 to 25 miles per hour; battery,

thirty cells, eleven-plate regular Exide, or Ironclad-Exide or Edison batteries may be furnished.

For model 20 the specifications differ only in wheel base, which is eighty inches, and number of cells, there being only twenty-eight of the regular battery. Cushion tires may be supplied with this model if desired. The specifications for model 24 are the same as for the roadster type, only that 34 by 4-inch cushion tires may be supplied.

The Broc Electric Vehicle Company also makes three additional models, namely, a victoria, a three-passenger coupé and a four-passenger coupé. The specifications for these models are similar to those already given.

COLUMBIA MOTOR CAR COMPANY.

The new 1911 Columbia brougham is much lighter than previous models and the construction throughout is adapted to the use of pneumatic tires, which, in combination with the special spring suspension, afford easy riding qualities.

With lightened construction, pneumatic tires, increased speed, improved control and steering and a more convenient and practical location of the driver's seats, the vehicle possesses great advantages over the best carriages of the earlier styles, and with these more important new features is combined every minor improvement

COLUMBUS CHAIN-DRIVE COUPE.

for further promoting the convenience and comfort of the occupants.

The inside seats accommodate four persons. The forward seat swings on hinges and when not in use may be lowered, leaving the forward space clear. The standard trimming is in rich dark green cloth. There are silk curtains, electric light with dome fixture in the ceiling, controlled from the inside, driver's electric signal, speaking tube, card case, memorandum pad and a mirror placed in a convenient pocket, also toilet case and electric cigar lighter, if desired. To these accessories may be added electric foot warmers for winter and electric fans for summer.

The most careful attention has been paid to the distribution of the constructive material used in the running

BROC ROADSTER.

and operating parts. Lightness has been obtained everywhere, but nowhere at the expense of strength. The frame is of pressed steel.

There are five forward and three backward speeds, with a maximum forward speed of eighteen miles per hour, while the lowest speed is four miles per hour. The controller handle is placed on the steering column beneath the wheel, adjacent to the driver's left hand.

An important advantage of the controller is its smoothness of operation. From a standstill, full headway may be obtained without apparent definition between the separate speeds as the lever is advanced through the series of five notches.

There are two powerful foot-operated brakes and a foot-operated cut-out safety switch, insuring absolute control under all conditions of crowded city traffic.

The underslung battery is of the latest type of Exide special, containing the forty-four cells carried in a single tray beneath the carriage body. Its capacity is 168 ampere-hours at forty-two-ampere rate. The method of suspension is exceedingly simple, making the tray easily and quickly removable.

The Columbia victoria phaeton, known as Mark 70, is a town carriage that has won admiration through seven years of use. The 1911 body is painted black with dark green panels, while the color of the gear matches the panels and stripe harmonizes with them. Its capacity is two persons and it has a normal speed of fourteen miles per hour with a maximum of seventeen, and the running gear is of the reachless type, one motor being used and the drive accomplished by chain. A General Electric, series-wound, forty-eight-volt motor is used. The type of battery in this phaeton is the Exide Hycap, the cells being grouped in special high-bridge jars. Twenty-four cells are employed and are set in two trays.

COLUMBUS BUGGY COMPANY.

The changes of particular importance in the Columbus electrics for 1911 are the incased chain and the shaft drive. In successfully inclosing the chain the Company has developed an improvement, the value of which is readily apparent. Running the drive chains in oil and keeping them perfectly lubricated and free from dirt and grit, relieve them of every objectionable feature. The Company asserts that this improvement increases the efficiency of the chain drive to the maximum; wear is practically eliminated; all noise disappears; and the aggravation of handling foul chains no longer annoys.

The model 1202 coupé shown in one of the accompanying illustrations is equipped with the new incased chain drive. The battery equipment comprises a thirty-cell Exide battery. model 1220 is a four-passenger shaft-

COLUMBUS SHAFT-DRIVE COUPE.

driven coupé. The car has an eighty-seven-inch wheel base, thirty-four-inch wheels and is equipped with Exide or Edison batteries. The two-passenger roadster, one of the most popular of Columbus electrics, is a unique design for an electric vehicle. It is equipped with fore doors which are so popular on the 1911 gasoline cars. In fact it is built along the same lines throughout as a gasoline roadster.

THE COUPLE-GEAR FREIGHT-WHEEL COMPANY.

While no radical changes have been announced by the Couple-Gear Freight-Wheel Company for its 1911 model electric and gas-electric vehicles, a number of improvements have been made which make for an even more efficient vehicle than in 1910. This Company manufactures two classes of vehicles, the gas-electric, comprising a gasoline engine driving an electric generator supplying current to the motors contained in the wheels, and a straight storage-battery electric vehicle.

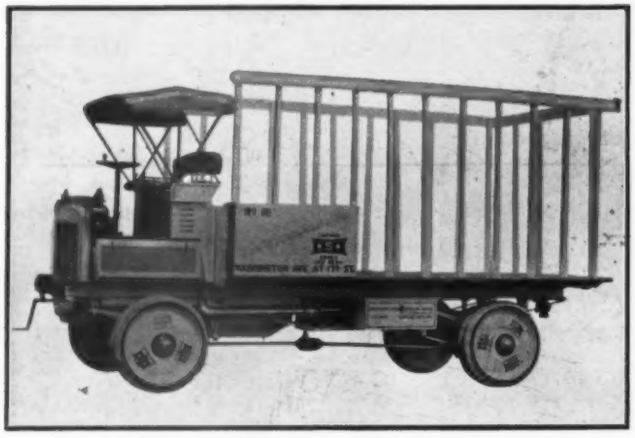
Both the storage battery and gas-electric types are made in five-ton and three-and-one-half-ton sizes and the same transmission is used in both types of trucks. This consists of a motor contained in each wheel, which applies force to the rim of the wheel at two opposite points. The axle stubs on which the wheel turns are integral with the motor castings. An elongation of the inside stub is keyed in a taper sleeve in the steering knuckle and this holds the motor in a fixed horizontal position while the wheel revolves around it. With the four-wheel drive has been developed four-wheel steering, which the Company claims is a great advantage. Four brakes are provided in addition to an electrical brake, which converts the four motors into generators.

The Couple-Gear Freight-Wheel Company has recently supplied to the Springfield (Mass.) fire department a special storage-battery ladder truck which is described in the following account, which appeared in one of the daily papers of that city:

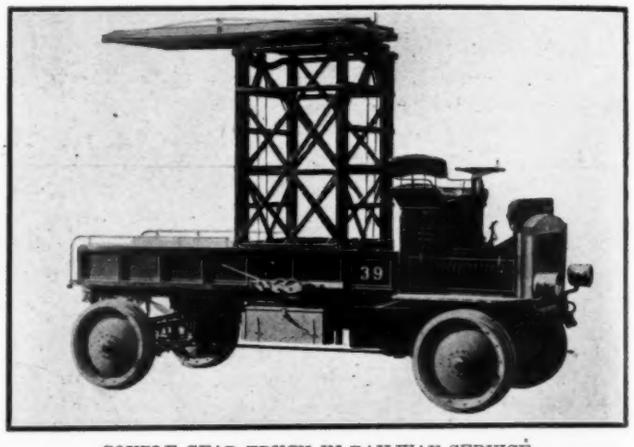
Springfield's new electric ladder truck made its appearance on the street in the afternoon and pleased the eye of all who saw it, especially the fire-department people. This is Springfield's second piece of electrically-driven fire apparatus, the combination hose and chemical wagon being the first. The new ladder was secured through the Combination Ladder Company of Providence, R. I., eastern agents for the Seagraves Ladder Company of Columbus, O., who made most of the truck parts except the chassis, which came from the Couple-Gear Freight-Wheel Company of Grand Rapids, Mich.

The ladder truck is about fifty-two feet long and the chassis is equipped with the peculiar couple-gear wheels, each of which has a separate motor. In these lie the tremendous power of the machine. Each can be operated separately, so that if one, two or three of the wheels give out while the truck is going or coming from a fire, it can be operated by means of the remaining good wheels. Numerous electric batteries stored in the chassis furnish the motive power, and these batteries are charged from time to time from the generator at headquarters. One of the chief features of the truck is the automatic hoist for the aerial ladder. Two cylinders inclosing heavy compressed springs furnish the power that throws the ladder into the air in an upright position without the use of cranks, and when the ladder gets to its upright position, a dog drops into place to keep it there.

The driver's seat is on the right-hand side of the truck, pretty well back from the head end, instead of on top and right up at the front, as on the old truck. The tires are of hard rubber, and double tread, doing away with danger of puncture. The maximum speed of the truck is twenty miles an hour.



COUPLE-GEAR FIVE-TON TRUCK.




COUPLE-GEAR TRUCK IN RAILWAY SERVICE.

GENERAL VEHICLE 2,000-POUND WAGON.

GENERAL VEHICLE 1,000-POUND WAGON.

GENERAL VEHICLE COMPANY.

The General Vehicle Company's vehicles for trucking and delivery are built on a uniform design of chassis, varying in size and power for different capacities and in style of body for the user's requirements. For the 1911 model vehicles very little change has

been made in the design of the chassis. The frame is constructed of pressed steel or steel channels of such proportions as will best support the mechanism and carry the load most efficiently.

The forty-four-cell storage battery which furnishes electricity to the motor at eighty-five volts is suspended below the main frame in a substantial cradle, where it can be reached easily. The battery is in sectional form in crates of such weight and size as can be easily removed and replaced from either side of the vehicle, entire or in sections. It is so arranged that it may be charged without removing, but if two batteries are used a charged battery may be easily substituted for the exhausted one.

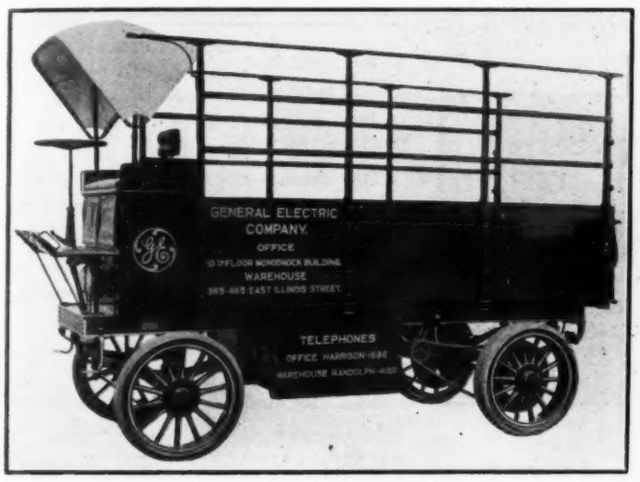
The controller is the continuous-torque type, which changes motor speeds by degrees without interrupting the power supply. This gives a smooth, even acceleration, which, it is said, increases the life of the controller, battery, motor, chains, etc.

The motor used on the General Vehicle Company's electric vehicles is especially designed for service demanded in electric transportation. It is built along sturdy lines, with strong, rigid shaft, durable brush fittings, and a capacity for heavy overloads. The motor is suspended on a cross-bar pivoted to the side frames in front of the rear axle. This pivoted suspension keeps the motor shaft parallel with the countershaft throughout the entire range of chain adjustment and permits the successful use of silent chain drive. The motor is totally inclosed and is placed high above the ground, where it may be easily examined.

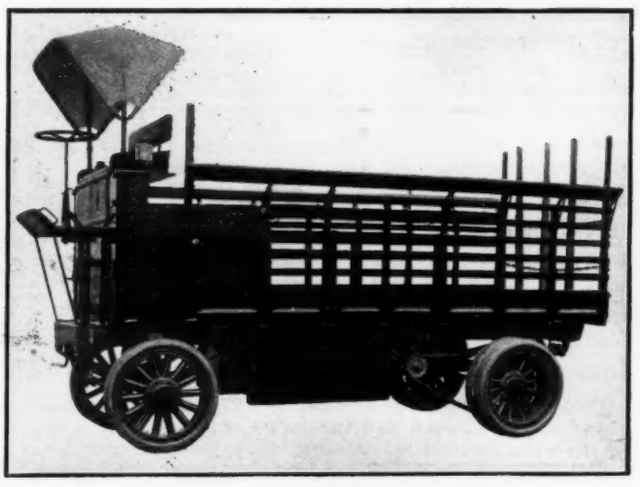
The countershaft is housed and provided with four roller bearings within the inclosing tube. This tube is held in self-alining ball sleeves in hangers riveted to the side frames of the chassis. The complete countershaft may be handled as a single unit. It consists of two short shafts connected by a differential of the spur-gear type, each shaft connected to a rear wheel through sprockets and roller chain. The countershaft is driven by a broad silent chain over differential gear and motor pinion.

In the accompanying illustrations are shown a number of representative types of General Vehicle standard wagons, ranging in size from the 1,000-pound light delivery wagon to the five-ton truck for heavy haulage.

The specifications for 1911 indicate an increased speed in miles per hour for the 1,000-pound wagon. The mileage travel on one charge for the 1,000-pound, 2,000-pound and two-ton vehicles is forty-five; for the three-and-one-half-ton truck, forty; and for the five-ton truck thirty-five miles. All general dimensions are slightly increased, thus providing increased useable room.




GENERAL VEHICLE TWO-TON TRUCK.



GENERAL VEHICLE THREE-TON TRUCK.

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THE LANSDEN COMPANY.

The Lansden Company, of Newark, N. J., manufacturers of electric trucks of all sizes, announce for 1911 a new feature applied to its five-ton electric trucks.

For years some new designer or engineer would suggest a control system whereby the electric in going down a hill should turn the motor into a generator and thereby return to the battery a very considerable amount of the extra energy required to climb the hill. The Lansden Company with customary conservativeness has not exploited this scheme in its inception; instead, the Company has actually used it for a period of two years, having covered a distance of over 19,000 miles with an experimental model.

A system of this kind on the level, of course, shows no increase in mileage over the ordinary series type of motor, but where grades in excess of a few per cent are encountered, a very considerable gain is effected, often thirty-five per cent returned to the battery on the down grade.

Another result of this simple method of control is that the truck becomes practically a constant-speed machine, climbing ordinary hills at practically the same speed as on the level and held back on the descents, not by brakes, but by the energy required to create the current returned to battery. This eliminates all the wear and tear due to breakage and means a motor wagon of the greatest efficiency and cheapest repairs.

The details of design have been completely worked out, both motor and controller being designed especially for the Edison battery, taking advantage to the full of its many unique and desirable qualities. The controller actually handles a very small quantity of current, only a fraction of that driving the machine, meaning much less wear and tear, less attention and adjustment and a greater assurance of safety.

With his customary thoroughness, Mr. Lansden has gone one step further in designing this five-ton truck, and by making radical departures has still further increased the truck's efficiency

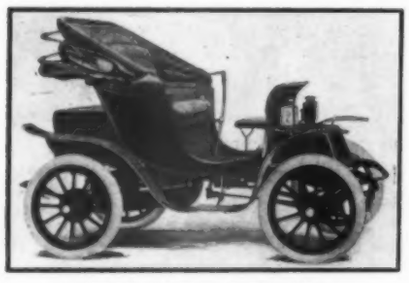
by using a helical spring suspension with flat-leaf springs as distance or reach rods. This cushions the strains of starting, of road obstructions, or of stopping, and a big five-ton truck rides and handles as easily and smoothly as does the ambulance.

STUDEBAKER AUTOMOBILE COMPANY.

In the accompanying illustrations are

STUDEBAKER COUPE.

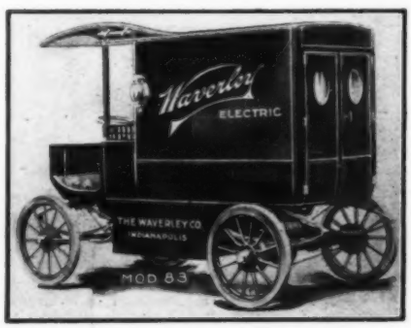
shown two of the newest type Studebaker electric pleasure vehicles, which are known as model 17. The specifications for both victoria phaeton and coupé are the same. The motor is of special design, with ample overload efficiency to carry the car over any reasonable grade. The battery equipment comprises twenty-six cells of eleven-plate Exide battery, part carried in front and part in rear, equalizing the distribution of weight. The wheel base is seventy-one inches and the diameter of the wheels thirty inches. The brake is of the foot-lever control type and is on the rear axle. There is also a brake



STUDEBAKER VICTORIA.

on the armature shaft which is operated by the controller handle.

In the commercial electric-vehicle line the Studebaker Company manufactures six standard models, each having a modification of four different power-plant capacities. Refinements of design have led towards simplicity and in the direction of low maintenance, and in this connection it may be observed that all driving wheels are of larger diameter than has been customary heretofore, thereby reducing the tire maintenance costs, as well as minimizing the power consumption and eliminating as far as practicable the jar to the mechanism of the vehicle. The new method of battery suspension adopted by the Company, in addition to having the advantage of larger driving-wheel diameter, has an independent spring suspension contained within the battery compartment, which adds materially to the preservation of the battery, and, to reduce the expense of repeated cleaning, battery cells with sufficiently high bridges to collect all of the material deposited during the life of the plates are employed. Throughout the machine provision for lubrication, wherever practicable, is of the standard railway-type waste-box method, thereby eliminating flimsy and unreliable grease cups, which are likely to be neglected




WAVERLEY 1,000-POUND WAGON.

or improperly regulated, and insuring continuous lubrication with the least possible personal effort.

THE WAVERLEY COMPANY.

The leading Waverley model for 1911 is said by the Company to be its model 81, a four-passenger brougham. Other models which have been changed and improved are 75-C, a four-passenger brougham; 70-C, a three-passenger coupé; 76, a victoria phaeton, and 78, an electric roadster.

The first mentioned car, model 81, is of the same type as the one that recently made a run from Philadelphia to New York with two passengers, covering 112 miles on winter roads, sometimes in six inches of mud and sometimes over deep ruts, in five and three-quarter hours—a midwinter performance that would do credit to any gasoline roadster of equal size. The car was equipped with the new Edison battery, which is now furnished with any model of Waverley electric at an additional price.

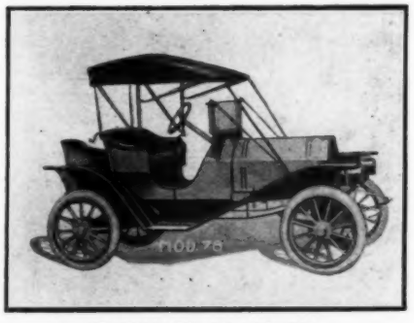
Model 81 is a four-passenger brougham, resembling in many respects last year's model 75-C, but with a few important differences. The body of the car is built in a single piece, three inches wider, the front has swelled side panels with rounded front quarter

WAVERLEY COUPE.

French plate glass, and the general effect of the car is larger, roomier, more luxurious and more distinguished.

The mechanical equipment includes the Waverley high-efficiency shaft drive, now in its third year of actual use in owners' hands; the Waverley no-arc controller, approved by Edison, and the Waverley motor that is said to give 360 per cent of turning power for each 100 per cent of overload.

Next to model 81 in point of newness, though actually surpassing it in novelty, is model 78, Waverley electric




WAVERLEY ROADSTER.

roadster, a car that was introduced last year, but only in a tentative form. Numerous alterations and improvements are embodied in this year's model. The body, for instance, is low hung. There is a roomy, comfortable rumble seat at the rear, with a step to reach it by. The length of the car has been increased to 114.5 inches and the wheel base to ninety-six inches.

# Current Electrical News

## GREAT BRITAIN.

*(Special Correspondence.)*

LONDON, JANUARY 28.—An action with regard to infringement of Osram lamps is not to take place after all, an agreement having been made between the General Electric Company of London and Messrs. Philips of Holland. The action was originally entered against Philips' London agents, but it was common knowledge that Messrs. Philips were finding the necessary funds to fight the case with. The whole position is a complete vindication of the Osram patents, for not only have Messrs. Philips agreed to an injunction against themselves, and will pay royalties, but agreements are being rapidly made with makers of other metal-filament lamps, with the result that, for a few years at any rate, there is likely to be a somewhat restricted importation of certain foreign lamps. With those firms which have come to terms there is also to be certain maintenance of prices and discounts. At the same time the matter is not quite settled, and an action or two may yet be necessary to give the owners of the Osram patents all that they claim. The case against Messrs. Philips was mentioned in the courts this week, it being withdrawn on Philips agreeing to judgment against them with costs.

An increase of no less than 3,000,000 third-class passengers is recorded by the London, Brighton & South Coast Railway Company during the December half year, the direct result of the working of the single-phase traction system. Attention is now being directed to the East London Railway, which has been allowed to lie almost derelict for many years. It is an important connecting link in London communication and an influential firm of electrical engineers is now carrying out a survey of the line with a view to preparing estimates of cost of conversion to electric traction. Owing to the height of the tunnels, the single-phase system is barred, and the third-rail continuous-current system will no doubt have to be adopted. This railway is in a somewhat curious position as it is really owned by five other London railway companies, who hitherto have not been willing to give the necessary capital for adapting the line to electric traction. But events are moving more rapidly now, and definite steps will be taken shortly.

Mention may also be made of a new type of rolling stock upon the Metropolitan Railway. Ever since the original adoption of the American type of car on London railways, the opinion has existed that they do not lend themselves to such rapid entering and leaving as the older compartment coach with a door to every carriage. The new type of car mentioned above is a modification of the two and is somewhat similar to the coaches on the South London single-phase line. The car is split up into compartments of three sections, each with a door, there being a gangway down the center, the virtue of which is that it affords greater convenience and more capacity.

Dugald Jackson, who is over here in connection with the transfer of the National Telephone Company's business to the Government, was present at the meeting of the Institution of Electrical Engineers recently and joined in the discussion on two papers dealing with electric power transmission. Mr. Jackson, whose remarks were of a general character, was accorded a very hearty welcome. The discussion was adjourned, the papers occupying most of the evening.

G.

## CONTINENTAL EUROPE.

*(Special Correspondence.)*

PARIS, JANUARY 23.—The new electric ozonizing plant for water purifying which is erected at St. Petersburg is the largest of the kind in Europe. The plant comprises several generators and electric appliances, besides the ozonizing apparatus proper. A means of purifying the city water was needed for some time past, owing to the bad quality of water which is furnished by the Neva River, and this led the municipality to adopt the ozone method. The plant uses a combination of Siemens ozonizing apparatus and water treating towers designed by the Paris Ozone Company.

In the region of Nice, France, there is to be installed a trackless trolley line which will connect various localities on or near the Mediterranean coast. Starting from Monaco, it is to follow a heavy gradient up the mountain slope to the locality of La Turbie, then reaching Menton, on the coast, and following along the coast route as far as Nice.

Two steam traction lines in France are soon to be changed over to the electric system. One of these is the light railway running between Severan and Claye, and the project has already been approved. The second line runs from Lens to Lievin.

Among new Austrian projects I note a light railway between the railroad station of Gravosa, on one of the state lines, to the town of Ragusa. It will be a single-track line equipped with overhead trolley. A project is on foot for an electric line between Baden and Mödling, and a meeting of local interests was recently held to promote the enterprise. Innsbrück is to have a second electrically-operated cable road up to the Hungerberg plateau, which is a much-frequented suburban resort. It is expected to carry a considerable traffic. Among the new projects I note a cable incline from Meran to the heights of Segenbühel, connecting here with an adhesion electric road which runs as far as Dorf Tirol. Another project relates to an electric line from Dolsach to Winklern, passing over the hill of Iselberge.

At the port of Dantzig the German wireless-telegraph department has erected a wireless post which is to be used especially for signaling to ships in order to warn them of approaching storms. It is operated in connection with the weather bureau. This is now the third wireless station of the kind to be installed on the coast of Germany.

An extensive steam plant has been installed at the Lesquin establishment, where the French Thomson-Houston firm is engaged in manufacturing Curtis turbines. The boilers serve to supply dynamo groups for running the motors for the machine tools of the shops and also for a large testing room which is used for the steam turbines. Four boilers are now installed, and their combined output is 40,000 pounds of steam per hour. They use forced draught given by two thirty horsepower motor-driven blast fans. Superheaters are employed so that the steam can be delivered at various temperatures for testing the turbines. The whole outfit is very well designed for obtaining various data upon steam turbines.

In France a company known as Energie Electrique du Centre, is operating an extensive power network in the region of Lyons, and now possesses seven hydraulic plants located on various streams. One of the principal of these is the turbine station on the Sioule River, and another has been lately erected at Olle, on the Romanche. Several steam plants are located in the large towns, such as Clermont-Ferrand, St. Etienne and others, and these are operated in parallel on the network. The power lines are worked generally at from 50,000 to 60,000 volts.

In Russia a government commission is examining a project for using the falls of Terek and also those of Lake Goktscha in order to operate hydraulic plants. In this way a good part of the Caucasus region would be furnished with current. A wireless station was opened not long since at Nikolajevsk, Siberia, and a second at Petropavlovsk. German apparatus of the Telefunken type is employed in both cases.

An electric railroad has been opened for service between Dresden and Klotzschhe. At Dahlenburg, Hanover, the electric plant is being increased considerably in order to supply the surrounding district. A tramway line is building at the town of Oos. I also note a project for an electric railroad in the regions of Hamburg, between Barmbeck and Schmalbeck, passing by Hansdorf.

## WESTERN CANADA.

*(Special Correspondence.)*

WINNIPEG, CANADA, FEBRUARY 4.—The City Council of Regina, Saskatchewan, plans great things for its municipal street railway system now nearing completion. During 1911 and 1912 no less than $450,000 will be spent on the system, half of which will be expended this year. The Council has mapped out the following programs of work:

1911—Laying of five and one-half miles of track at a cost of $135,000; purchase of six more cars for $38,500; snow sweeper, $4,500; addition of another power unit, $20,000; car barns, $15,000.

1912—Laying of six miles of track at a cost of $140,000; purchase of seven cars costing $44,000, with $50,000 left for other improvements and incidentals.

A report made to the Ontario Government by the Municipal Commissioner of Port Arthur, Ontario, shows there are 1,922 telephones in use in that city on the municipal lines divided as follows: individual subscribers' lines, 1,113; local party lines, 280; local subscribers on party lines, 623; extension telephones, 186.

Estimates and specifications prepared by the city electrician of Vancouver, B. C., show that from $150,000 to $200,000 will be expended this year in that city by the electrical department. The money will be expended on new pole lines, additional lamps and improvements to the distribution plants.

Commissioner Graves, of Calgary, Alberta, who was instructed by the City Council to look into the power situation and shortage, has prepared specifications for additional machinery to relieve the situation. Another boiler will be added at the power plant, new substations built and additional districts served, and many of the down-town wires placed under ground. The plans call for the expenditure of over $300,000 and work on the improvements will

be started as soon as the details have been approved by the City Council.

A petition bearing 288 names has been forwarded to the Department of Public Works at Victoria, B. C., for a telephone line from Nelson to Waneta, passing through Ymir, Salmo, Erie, South Lootenay and several smaller places.

Bids will be received by F. C. Patterson, chairman of the Manitoba Telephone Commission, Winnipeg, Manitoba, until noon, February 14, for all supplies required by the Commission for extensions and repairs during 1911. Specifications may be had from Mr. Patterson.

The Winnipeg Electric Street Railway Company, of Winnipeg, Manitoba, has paid a check for $63,293 to the city, being five per cent of the gross earnings for 1910, the total earnings of the company being $1,265,874.

After carefully looking over the situation the power engineers in charge of the power plant being built at Point du Bois by the City of Winnipeg, Manitoba, estimate that before the plant is completed additional machinery will be required at a cost of $980,000 and at the next meeting of the City Council a by-law will be introduced to provide for this equipment. Much better time must be made, they say, if the plant is to be completed by July 1 of this year, the date set for the formal opening. Cecil B. Smith is chief hydroelectric expert for the city.

During the current year the Manitoba Telephone Commission will spend $2,000,000 on improvements and extensions to its system. So far the detailed plans have not been made public but of this amount $500,000 will be devoted to the construction of new rural lines in various parts of the province.

## COMMISSION NEWS FROM WISCONSIN.

*(Special Correspondence.)*

The Supreme Court of Wisconsin has handed down a decision of very great importance affecting the powers of the Commission. The question decided came to the Supreme Court on an appeal from the Circuit Court of Manitowoc County where the Trial Court refused to make permanent a temporary injunction obtained against the Manitowoc & Northern Traction Company, restraining the Company from raising the rate of fare between Manitowoc and Two Rivers from ten cents to fifteen cents. The Company had failed to have the increased rate passed upon by the Railroad Commission. The city contended that by the terms of a franchise granted to the railway company by the city the rate of ten cents was established and that the Company could not change this rate without violating its franchise. The Supreme Court stated that the State has never surrendered its governmental power of fixing rates, but that by Sections 1682 and 1863 of the revised statutes, that power was merely suspended until such time as the state saw fit to act.

The Durand Light & Power Company applied to the Commission for authority to increase certain of its rates for commercial lighting. The Company requested permission to put into effect the following schedule: Business houses, fifteen cents per month per active unit (consisting of fifty-watt carbon or forty-watt Mazda lamp), plus four cents per kilowatt-hour for current consumed. For occasional users, twelve cents per kilowatt-hour. Minimum monthly charge, seventy-five cents. Residences, churches and halls, fifteen cents per month per unit for sixty-five per cent of the active units, plus four cents per kilowatt-hour for the current consumed. The applicant claimed that the revenues now received were inadequate to furnish a reasonable return upon a plant worth $55,000. The commission found that $40,000 would more nearly measure the value of the plant. It was also found by the Commission that the plant was furnishing current to several mills for power purposes and that the revenue from this service was very much less than the expense of serving these consumers. The Commission found that the present rate schedule of the Company was inequitable, and that the situation when taken as a whole justified the following rates: For business houses, a charge of fifteen cents per month per active fifty-watt carbon or per forty-watt Mazda lamp, when the active load constitutes sixty per cent of the connected load, plus four cents per kilowatt-hour for the current used. For residences, churches and halls, a charge of fifteen cents per month per active unit, when thirty-five per cent of the connected load is considered active, plus four cents per kilowatt-hour for the current used. A minimum charge of seventy-five cents per consumer per month may also be charged.

The Campbellsport Electric Company has made a proposition to the Village of Lomira to construct a transmission line to that village and supply current at a rate of fourteen cents per kilowatt-hour with a discount of ten per cent for prompt payment. The transmission line will be about eleven miles long. The Company has just constructed a new gas-producer plant at Campbellsport. The Village of Lomira has requested the Commission to investigate and inform the village as to the reasonableness of the rates and contract offered by the Company.

The Commission has recently handed down its decision in the matter of the complaint of the City of Sheboygan against the Sheboygan Railway & Electric Company. This complaint involved the rate and quality of service for lighting the streets of Sheboygan. The city alleged that the Company had failed to live up to the contract and had failed to give a light of as high a candlepower as was provided and that the Company had failed to give proper care and attention to its street lights. It was left to the Commission to determine upon a fair rate for this service and to specify what constituted a fair and adequate street-lighting service. Extended tests were carried on by the Commission's staff in a number of cities in the state and the results of these tests are described in the decision and comparisons made with the service in Sheboygan. Under the terms of the agreement between the Company and the city and the Company bound itself to furnish to the city arc lamps of "full 2,000 candlepower" to burn each night from thirty minutes after sunset until thirty minutes before sunrise, for which payment was to be made at the rate of $74.00 each per year. Previous to the agreement mentioned the Company had been supplying the city with street-lighting service furnished by 9.6-ampere, direct-current, open series arc lamps for which payment was made at the rate of $95.00 per lamp per annum. One year before the expiration of the old contract and the drawing up of the agreement previously described, the Company had substituted for the lamps then in use 7.5-ampere, alternating-current, enclosed series arcs, which are the ones now in use and against which the city brings its complaint. No words appear in the contract which might be descriptive of the lamps which the Company was to furnish.

The Commission quoted rather freely from the opinions and writings of illuminating engineers throughout the country and gave especial attention to the results of the Colorado Springs controversy, as regards the efficiency of various types of lamps and as regards the value and meaning of the term "2,000 candlepower."

The conclusions drawn from the investigations conducted are that the equipment of the Sheboygan Railway and Electric Company is not being operated so as to render a fully normal street-lighting service. The shunt type arc lamp, such as is used in Sheboygan, is not recommended by the makers for use on circuits having as large a number of lamps as those in Sheboygan. The Company should provide itself with such equipment and adopt such methods and practice as will insure greater uniformity in the adjustment and operation of the lamps in use upon its street-lighting system, and the standard to be used should be a consumption of 480 watts between the lamp terminals, an electrical pressure across the arc of seventy-two volts and a current value of 7.5 amperes. The lamps should be trimmed, cleaned and otherwise operated under such conditions that the illuminating power of the arcs, adjusted as above described, shall not be diminished.

"Wattage tests, although not indicative of the amount of light given by a given arc lamp, are, when measured at the lamp, an indication of the series lamp's adjustment. Wattage measurements were made upon nineteen lamps in Sheboygan, while the lamps were connected in their usual place of service; and it was found that the average power taken per lamp was 430 watts. Similar measurements made upon forty-two lamps in three other cities gave, as an average consumption per lamp, 474 watts. This latter value approximates very closely the normal wattage of 480. Using 480 watts as a basis of comparison, the street arc lamps in Sheboygan fell short of proper service by about ten per cent."

The inspectors made candlepower measurements, at forty-five degrees below the horizontal, for fifty-two street arc lamps in Sheboygan. The average intensity, at this angle, was determined to be 210 candlepower. Tests made by the inspectors upon forty-seven lamps in other cities gave an average of 292 candlepower. The difference in the average candlepower measurements is about twenty-eight per cent. The average illumination falling upon a vertical plane, fifty feet distant from a point beneath the lamp, as observed from tests upon forty-five lamps in Sheboygan, was .068 foot-candles, while similar tests upon fifty-five lamps in other cities resulted in a determination of an average of .083 foot-candles. This difference is about eighteen per cent. Tests were also made at greater distances.

In conclusion the Commission states in its decision: "From these considerations of the facts, it appears to us that under present conditions a rate of $68.00 per street arc per year would be a reasonable rate for the arc lighting involved in these proceedings, and that the respondent should take such steps as may be necessary to bring the service up to a point where it can be regarded as reasonably adequate. It is therefore ordered, that the rate for the street lighting service in Sheboygan shall not exceed $68.00 per arc lamp per year, and it is further ordered that this service be so improved as to become reasonably adequate."

## COMMISSION NEWS FROM MASSACHUSETTS.

*(Special Correspondence.)*

The Board of Gas & Electric Commissioners has made an investigation of the circumstances affecting the transmission of electricity for light, heat and power, and examined the laws relative to the location of lines and the authority of local officials and of the Board in enforcing the laws. At the hearing given by the Board four subjects were discussed: (1) The expediency of granting the right of eminent domain for the location of transmission lines; (2) an appeal in the event of a refusal of location by the town authorities; (3) changes in the law relative to the location of electric lines in public ways; (4) the proper regulation of high-tension lines which pass through several cities or towns. Several revisions of the old law were recommended by the Board, among which was a

specification that all lines operating at a higher voltage than 2,000 volts should be carried on poles not made of wood. Such poles must also be marked "dangerous." It is also provided that the Board may grant the power company a location for a transmission line through a town in case the town authorities refuse to grant it. Provision is further made for the establishment of underground districts.

Although the Board stated that the time might not be far distant when the proper development of electrical distribution would require the right of eminent domain to be exercised, a bill would not be justified at the present time. A recommendation was made that such legislation be postponed.

## COMMISSION NEWS FROM NEW YORK.

*(Special Correspondence.)*

The Public Service Commission, Second District, has denied the application of the receivers of the Hudson River Electric Company to exercise a franchise granted it by the village of South Glens Falls. The field, which is a small one, is now occupied by the United Gas, Electric Light & Fuel Company of Sandy Hill and Port Edward. At the hearing it was shown that this company has a plant sufficient to supply proper service to the village of South Glens Falls, and that no reason appears why a new company should be allowed to enter this village for the purpose of furnishing electric lights. The Hudson River Company secured a franchise from the village on an agreement to light the streets of the village at the rate of $63.87 per arc light, whereas the existing company asked $72 per arc lamp. In order that the village should have the lowest rate obtainable for lighting its streets, and at the same time the existing plant be protected from competition in such a small field, it advised the United Gas, Electric Light and Fuel Company that it should light the streets of the village at the rate offered by the Hudson River Company, or the Commission would feel obliged to allow the Hudson River Company to exercise the franchise granted by the village, The United Gas Company has filed with the Commission a stipulation agreeing to furnish lights at the rate of $63.87 on a five-year contract. If the provisions of this stipulation are not carried out, the Hudson River Company can renew its application to light the streets of the village.

The Public Service Commission has authorized the Lockport Light, Heat and Power Company to issue its thirty-year five-per-cent bonds upon the security of its first refunding mortgage to the aggregate principal amount of $70,000, the bonds to be sold at not less than eighty-five and the proceeds to be used for the improvement and extension of its plant and distributing system, and for the discharge of indebtedness incurred for proper capital purposes.

## IMPORTANT DEVELOPMENTS.

*(Special Correspondence.)*

PROPOSED DEVELOPMENT IN ALABAMA.—The Hydro Electric Company has asked the co-operation of the United States Government in developing the magnificent water power running to waste on the Tennessee River at the three twin cities of this state —Florence, Sheffield and Tuscumbia. The river at these three places is known as Muscle Shoals, being fifteen miles long, with a fall of 150 feet, and is said to be the second greatest water power in the United States. In order to make the river navigable the Government some years ago built a canal around the shoals at a cost of $8,000,000. It has been found, however, that the canal is not adequate for present needs, and almost $8,000,000 more is needed and has been recommended. The proposition of the Hydro Electric Company to the Government is that the company will aid the Government in rendering the river navigable if the latter will assist in developing the water power running to waste. The electric company wants to build three dams across the river with adequate locks. The dams will conserve and develop 180,000 horsepower, and the three locks will open the river to full and adequate navigation of all boats that may ply the river in the future. The Hydro Electric Company has offered to put up one-half of the money if the Government will put up the other half, and the two are now within less than $2,000,000 of an agreement. The development of the power means an adequate supply of electricity for all purposes for a territory covering a radius of about 150 miles of the shoals. T.

PROPOSED MEXICAN DEVELOPMENT.—It is authoritatively announced here that the Canadian syndicate headed by William Mackenzie, of Toronto, Canada, president of the Canadian Northern Railway, which already owns the extensive electric railway and lighting system in Monterey, Mexico, has acquired the concession that was granted by the Government some time ago for the construction of a large dam across the Balsas River and the installation of a large hydroelectric plant in the state of Guerrero. It is announced that the contract for the construction of the dam has been let and that the structure will cost approximately $3,000,000 gold. The dam will be 150 feet high and will be located in the canyon of the river near the end of the Cuernavaca, Mexico & Pacific division of the National Railways of Mexico. The proposed hydroelectric plant will have an initial capacity of 30,000 horsepower. This electrical energy will be transmitted to Chilpancingo, capital of the state of Guerrero, and to a number of mining districts of that region. D.

## LIGHTING AND POWER.

*(Special Correspondence.)*

HORTON, KANS.—This city contemplates the installation of an electric light plant. P.

ARLINGTON, ORE.—C. H. Busey has applied for an electric lighting franchise in this city. A.

CHADRON, NEB.—Kass & Klingman have been granted a franchise for an electric light plant. P.

BERTHOLD, N. D.—John I. Moore has been granted a franchise for an electric light plant. P.

FARMINGTON, MINN.—L. Larson has applied for a franchise to install an electric light plant. C.

GRAND RAPIDS, MINN.—It is proposed to extend the electric light and power lines to Laprairie. C.

ADAIR, IOWA.—Bonds for $10,000 have been voted for the establishment of an electric light plant. P.

CHAPPELL, NEB.—A vote will be taken on the installation of an electric light plant in this place. C.

KIRBYVILLE, TEX.—J. W. Fleming and J. Morton are arranging to install an electric light plant here. D.

CANYON, TEX.—L. T. Lester and L. E. Cowling have been granted a twenty-five-year electric light franchise. P.

WEBSTER CITY, IOWA.—The city has secured a site for the erection of a light and power plant to cost $50,000. C.

FORT STOCKTON, TEX.—Clay Brothers, of San Angelo, Tex., have been granted an electric light franchise here. P.

CELINA, TEX.—The Celina Electric Light & Power Company has been incorporated yith a capital stock of $5,000. P.

FORSYTHE, MO.—John A. Laird, of St. Louis, plans the construction of a big water-power electric plant near here.

TOMBSTONE, ARIZ.—J. S. Douglas, of Douglas, and others, have been granted an electric light franchise in this place. P.

STEAMBOAT ROCK, IOWA.—Plans have been arranged at Iowa City for the construction here of a dam to develop power for local use. C.

LEE'S SUMMIT, MO.—L. Z. Morris and others have incorporated a company with a capital of $20,000, to install electric lights here. P.

BONDUEL, WIS.—Dietrich & Brandt, owners of the Bonduel roller mills, are planning the establishment of an electric light plant. C.

WAUBAY, S. D.—Boyle & Weller, of Webster, S. D., have petitioned for a franchise for the installation of an electric light plant. C.

ORLAND, CAL.—C. R. Wickes has been granted a franchise for an electric light and power system to extend to the limits of this city. A.

JOLIET, ILL.—The Economy Light and Power Company announces that its ornamental street lighting system will be installed by June 1. Z.

MOBRIDGE, S. D.—Tanner Brothers, of Webster, and Hill & Smith of Mobridge, have applied for franchises for the installation of an electric light plant. C.

WILLOWS, CAL.—The Northern California Power Company has been granted a two-year contract for electric lights in the business portion of this city. A.

PALMYRA, MO.—The Palmyra Commercial Association is furthering a movement to install decorative electric lights in the business section of the town. Z.

DULUTH, MINN.—It is proposed to have the Legislature pass an enabling act to permit of a vote being taken on issuing $700,000 bonds for a municipal electric light plant. C.

HELENA, ARK.—The Helena Gas & Electric Light Company has been incorporated to supply Helena with electricity and gas; The capital stock is $300,000, all subscribed.

WALLACE, N. D.—The Duplin Light & Power Company of this city, has been incorporated by J. C. Causey, Jr,. of Wallace, and others, with a capital stock of $10,000.

SUMTER, S. C.—The plant and interests of the Sumter Ice, Light & Power Company have been sold to Philadelphia capitalists at a price reported to be about $150,000.

BROOKSVILLE, FLA.—A new electric light plant is to be in operation here in a short time. The Hillsborough Hardware Company, of Tampa, will furnish the machinery.

ROCHESTER, MINN.—It is proposed to move the electric light plant nearer the river and install a system of cluster lighting from plans by Earl Jackson, engineer, St. Paul, C.

WHAT CHEER, IOWA.—The What Cheer Electric Light Company has been incorporated with a capital of $4,000. The incorporators are B. Wilson, L. C. Wilson and Robt. Bowie.

WALDRON, ILL.—Beardsley & Menfesty have sold the power plant here to Kelsey, Brewer & Company for $60,000. The power may be used later to supply Kankakee, Ill. Z.

MEADE, KANS.—The Meade Light & Power Company has received from Fairbanks, Morse & Company a thirty-seven kilowatt, 2,300-volt, three-phase alternator direct connected to a solar oil engine.

VIRGINIA, MINN.—The Board of Education let the contract to the Richmond Electric Company, of Duluth, Minn., for the installation of a switchboard in the new high school building for $1,927. C.

TEMPLE, TEX.—The Gulf, Colorado & Santa Fe Railroad will install a complete electric power and lighting system for its shops, terminals and other property here. The general offices are at Galveston. D.

PASADENA, CAL.—An elaborate system of street-lighting extension is being planned by the Municipal Light Department, and a large number of street arcs and series tungsten lamps will be installed.

EARLVILLE, ILL.—The Earlville Electric Light & Ice Company has incorporated with a capital of $25,000. The incorporators are C. A. Frank, J. A. Dupee, A. C. Sadler, Geo. W. Mundie and F. B. Keeler.

SAN ANTONIO, TEX.—The San Antonio Gas and Electric Company and its affiliated concern, the San Antonio Traction Company, will make extensive improvements and extensions during the present year. D.

HOUSTON, TEX.—The Houston Electric Company, which is a Stone-Webster property, will expend about $400,000 in relaying track, making extensions and in other improvements during the present year. D.

MINNEAPOLIS, MINN.—Property owners along Tenth Street South between Nicollet and Fourth Avenue South are planning an ornamental light system. R. J. Randolph, of Motor Mart, is active in the movement. Z.

SAN FRANCISCO, CAL.—Chas. W. Slack and others have incorporated the California Power & Manufacturing Company, with a capital stock of $5,000,000. The company plans to operate in Northern California solely. A.

CENTRAL CITY, IOWA.—It has been voted to grant a franchise to Fred A. Cross, of Monticello, for the construction of an electric light plant. The plant will also supply light and power to Coggon and Centerpoint. C.

BRIDGEPORT, ILL.—The Bridgeport Light and Power Company has been incorporated with a capital stock of $20,000 to supply light, heat and power. The incorporators are R. D. Donnelly, W. E. Boyhan and F. H. Lytle. Z.

BENSON, ARIZ.—R. G. Arthur has been granted a franchise for an electric lighting plant here. Mr. Arthur has incorporated a company the other members of which are: M. J. Cunningham, S. F. Meguire, W. M. Adamson and Peter Jensen.

BARRY, ILL.—The Barry Electric Light and Power Company has been incorporated with a capital stock of $4,000 to supply electricity for heating, lighting and power. The incorporators are Frederick Frike, W. I. Klein and A. R. Weeks. Z.

OGDEN CITY, UTAH.—A. L. Brewer, J. S. Lewis, M. S. Droning, A. T. Wright, Joseph Scorcraft and J. N. Sparge have been granted an electric lighting franchise in this city. Work on the construction of the plant to commence within six months.

EAST ST. LOUIS, ILL.—The Missouri Avenue Improvement Association is a new city-beautifying organization. A street-lighting committee has been named as follows: Dr. H. C. Fairweather, J. B. Messick, W. H. Hauss, Fred Kraft and Ben Boul. Z.

PINE RIVER, MINN.—Pine River's electric light plant has commenced operations. The first light was had when the power company tested its dynamo and wiring and now permanent service has been inaugurated. The plant is a hydroelectric installation.

BISHOP, CAL.—B. F. Mechling, commercial agent for the Nevada-California Power Company, announces that his company will extend its power lines in the lower Owens Valley this year, having had enough business signed up in that territory to warrant the step. A.

DAYTON, O.—A. Bentley & Sons of Toledo have been awarded a contract to build a $130,000 addition to the Beaver Power Building in this city. The Beaver Building is a central plant used by a large number of small manufacturers. The addition will be of concrete construction.

DAVENPORT, IOWA.—Samuel S. Davis and Thomas D. Davis let the contract to the Westinghouse Electric Manufacturing Company for one exciter, one motor generator set, six vertical generators and a seventeen-panel switchboard to be installed at the Sears waterpower development plant. C.

SPOKANE, WASH.—D. L. Huntington, president of the Washington Water & Power Company, states that a new power house will be built by his company this year, on the Spokane River, near the recently completed Little Falls plant. A transmission line is to be built from the new power house to this city. A.

MONTGOMERY, ALA.—Richard Tillis recently made the statement that, in the event of his being compelled to turn over the stock of the Citizens' Light & Power Company to H. L. Doherty & Company, he stands ready to build a new $400,000 lighting plant. A franchise has already been procured for the new plant.

WATERVILLE, ME.—The Central Maine Power Company of this city has voted to issue $150,000 more preferred stock. The Company, which operates a large electric plant, formerly was authorized to issue $2,500,000 common stock and $500,000 preferred stock, so that the total now authorized is $13,150,000.

POLSON, MONT.—It is reported that active construction work will begin in the early spring on a hydroelectric plant to furnish this city and vicinity with light and power. The power site which is a natural one, of 800 feet effective head, is located within eight miles of this city. Frank F. Faucett, of Polson, is engineer.

MILAN, O.—As a measure of economy it is possible that the village will abandon its municipal lighting plant and accept the recent proposition of the Hoover-Prout Company, which operates a potato digger plant at Avery, near here. The company offers to supply power for a little more than four cents per kilowatt-hour while the present price is from six to ten cents. H.

REDWOOD CITY, CAL.—The Sierra & San Francisco Power Company has filed amended articles of incorporation in this county. The company's principal place of business has been changed to Milbrae. This company has a capital stock of $20,000,000, has a hydroelectric plant on the Stanislaus River and is chiefly engaged in supplying power for the operation of the street-car lines of the United Railroads of San Francisco. A.

SAN FRANCISCO, CAL.—The Sierra Blue Lakes Water & Power Company has been incorporated in this city with a capital stock of $75,000. The stockholders and directors of the company are: Adelaide Sullivan, Eugene J. Sullivan, Walter E. Sullivan and George H. Richardson. The entire amount of the capital stock is subscribed. The company is the owner of water and power rights on Blue Lakes and on the Mokelumne River, and is authorized to develop and operate these. A.

FALL RIVER, MASS.—At the annual meeting of the Fall River Electric Light Company the following-named officers were elected: Clerk and treasurer, Owen Durfee, Fall River; directors, Edward L. Anthony, George A. Ballard, Jerome C. Borden, Frederick O. Dodge, Albert F. Dow, Robert S. Goff, Oliver S. Hawes, James E. Osborn, Spencer Borden, Jr., Fall River; Philip Cabot, Robert S. Hale, Boston. The directors elected Albert F. Dow, president; and Philip Cabot, vice-president.

GUANAJUATO, MEX.—The third hydroelectric plant which the Guanajuato Power and Electric Company is installing on the Angulo River in the state of Michoacan is nearing completion. It will give the company a total capacity of 20,000 horsepower. The new transmission line to San Luis Potosi, eighty-seven miles, is now in regular operation. One of the important things accomplished by the company last year was the purchase, through its subsidiary, the Central Mexico Light and Power Company, of the power and electric light plant at San Luis Potosi for $700,000. D.

AUGUSTA, ME.—The Central Maine Power Company has recently purchased the controlling stock of the Skowhegan Electric Light Company which has been doing business in Skowhegan. The purchased plant has a development of about 600 horsepower, with an auxiliary, steam, of about 500 horsepower. It is the intention of the Central Maine Power Company to connect the Skowhegan system with the system in this part of the county. Eventually the lines will be connected with these the company control in Solon and Bingham. This company has applied for pole location in Winslow

VANDALIA, MICH.—The Central Station Development Company reports that at the election held recently on the question of granting the Milling & Power Company, of Cassopolis, Mich., a franchise for light and power for thirty years, the provision carried by a large margin. The Milling & Power Company obtains current from the Constantine Hydraulic Company's dam at Constantine, Mich. A contract will be executed for street lighting for ten years. The installation will require about forty street series Mazda lamps. The transmission line from the dam at Constantine to Cassopolis passes through Vandalia.

SACRAMENTO, CAL.—The Pacific Gas & Electric Company announces that it will spend approximately $1,000,000 in this city during this year. This sum is to be spent in erecting and equipping a plant to generate electricity by steam instead of the hydroelectric system the company now employs, in the improvement of the steam-railway system and in additions to the gas plant. The plant for generating electricity will alone cost about $500,000, exclusive of the ground on which it is to be erected. Construction will commence next month. The equipment will include a steam turbine with an average capacity of 15,000 horsepower. A.

AUSTIN, TEX.—The Board of City Commissioners has under consideration another offer to rebuild the great dam across the Colorado River and install a hydroelectric plant here. The Dumont-Holmes Steel Concrete Company, which was awarded the contract several months ago, has failed to carry it out and its rights have been declared forfeited by the City. The new offer comes from George D. Moore, of Detroit, Mich. He purposes to build the dam and install the hydroelectric plant for $1,000,000, this sum to be paid in semi-annual installments of $25,000. The proposed new dam will be located on the site of the one that was destroyed by a flood in the river several years ago. D.

## ELECTRIC RAILWAYS.

*(Special Correspondence.)*

HIBBING, MINN.—The survey for an electric railway to Eveleth and Gilbert is being made. C.

WATERLOO, IOWA.—The construction of an interurban line to Cedar Rapids is being agitated. C.

WAHPETON, N. D.—It is proposed to extend the Wahpeton-Breckenridge street railway line to Hankinson. C.

EAU CLAIRE, WIS.—The Chippewa Valley Electric Railway, Light and Power Company is planning extensive improvements for the near future. C.

SAULT STE. MARIE, MICH.—The construction of an electric line to Pickford is proposed, with the idea of continuing it later to De Tour or St. Ignace. C.

ALBERT LEA, MINN.—H. W. Knight, of Chicago, and E. G. Boyle, of East Chain, are considering the construction of an electric line to Worthington. C.

KNOXVILLE, IOWA.—S. G. Durant, from Ohio, is considering the construction of an interurban road to Dallas, if $50,000 is subscribed by citizens of Knoxville. C.

DETROIT, MICH.—A large order has recently been placed with the General Electric Company for sixty two-motor, seventy-horsepower car equipments for the Detroit United Railways of this city.

ROCHESTER, IND.—Nearly $75,000 has been subscribed to build trolley line from Rochester to Akron. When this line is built it will be a easy matter to extend the line to Wabash by way of Roann. S.

LA PORTE, IND.—The interurban system of the Chicago and New York Air Line, connecting La Porte and Chesterton, has been completed. Cars will be running in a short time. The line will be constructed west to connect with the Gary interurban, and by June 1 it is planned to have cars running between La Porte and Hammond. S.

JASONVILLE, IND.—The proposal of an electric road to connect this city and Brazil has aroused interest to the extent of petitioning for subsidy elections in the townships through which the thirty-mile road will pass. The road would be of great advantage to the territory and there is every indication of its being built in the near future. S.

PORTAGE, WIS.—The Chicago & Wisconsin Valley interurban road has placed orders for 1,000 tons of steel rails and 20,000 ties to be used in the construction for the city lines of the road. The contract for the ties was let to the Brown Land & Lumber Company, of Rhinelander. C.

MODESTO, CAL.—The city trustees of this place have advertised for sale an electric railway franchise asked for by the San Joaquin Valley Electric Company of Stockton, which is now building from Stockton to Modesto. The franchise will provide for an entrance into Modesto. A.

AURORA, ILL.—The lines of the Aurora, Elgin & Chicago Railroad will be extended from Yorkville to Plano and Sandwich and Somonauk. Petitions have been filed in the circuit courts of Kane and Kendall Counties asking that the by-laws of the company be amended to make the extension legal. Z.

DE KALB, ILL.—The lines of the Aurora, Elgin & Chicago Railroad are to be extended from Yorkville to Plano and Sandwich and Somonauk. Preliminary legal proceedings necessary before the extension can be built have been started in Kane, Kendall, DeKalb and other counties in which the company operates.

AKRON, O.—The Northern Ohio Traction Company has placed a large order for new equipment with the General Electric Company. The order included one 1,000-kilowatt motor-generating set, a seventy-five-kilowatt generator, a 115-horsepower motor and eight four-motor car equipments, including controllers and a switchboard.

OKLAHOMA CITY, OKLA.—Stockholders of the Oklahoma Railway Company will meet February 24 to consider a proposition to increase the capital stock from $3,000,000 to $15,000,000. Of this amount $5,000,000 will be preferred stock. The bonded indebtedness of the company, if the stockholders agree, will be increased by a bond issue of $12,000,000. Z.

RENSSELAER, IND.—Local capitalists are considering a plan to secure the interest of Eugene Purtell in the Northwestern Indiana Traction Company with a view of building the road. Purtell has gone into bankruptcy. The line, on which some work has been done, some franchises secured and some subsidies voted, was planned to run from Monticello to Hammond. S.

KANSAS CITY, MO.—Frank A. Faxon was named chairman of a committee to canvass the proposition to build an electric railway from Kansas City to Excelsior Springs through Liberty. Representatives of J. Ogden Armour were present and a proposition was made to lease the new bridge of the Union Depot Bridge and Terminal Railroad Company, while that corporation would build four miles of new track through its thirty-five hundred acres of land in Clay County. The Metropolitan Street Railway Company offered to sell power and co-operate to bring the suburban cars into Kansas City over the bridge and its lines. Z.

## TELEPHONE AND TELEGRAPH.

*(Special Correspondence.)*

GERMANTOWN, MINN.—Farmers have decided to construct a telephone line to Esplee. C.

NEW LONDON, IOWA.—The plant of the telephone company was damaged by fire very recently. C.

WELLSURG, IOWA.—Farmers are considering the installation of a new telephone exchange. C.

DES MOINES, IOWA.—Business men are circulating petitions for the installation of the automatic telephones. C.

PIERRE, S. D.—The Great Eastern Telephone Company has been incorporated with a capital stock of $100,000. P.

HITCHCOCK, S. D.—The County Line Telephone Company has been incorporated with a capital stock of $25,000. P.

MONTICELLO, IOWA.—The Bell Company will expend $10,000 rebuilding its lines during the coming spring. C.

INDUSTRY, ILL.—Reports of the Industry Telephone Company show a surplus, all debts having been cleared. Z.

MENLO, IOWA.—The Farmers' Mutual Telephone Company is considering the establishment of a number of toll lines. P.

SANTA FE, N. M.—The Valley Telephone Company has been incorporated in Anthony, N. M., with a capital of $50,000. P.

ORCHARD FARM, MO.—The Orchard Farm Telephone Company has been incorporated with a capital stock of $1,950. P.

JESSUP, IOWA.—The Farmers Mutual Telephone Company will install a new switchboard and other needed improvements. C.

WAVERLY, IOWA.—The Washington Rural Telephone Company has been incorporated with a capital stock of $6,000. P.

GRAND CANE, LA.—The Cumberland Telephone Company has rebuilt the local system, recently put out of operation by fire.

GREENVILLE, TEX.—Citizens of Cash are building a trunk telephone line from that place to this city, a distance of eight miles.

NEWTON, IOWA.—The Murphy Mutual Telephone Company, is considering the installation of a small switchboard in order to reach Kellog. C.

CEDAR RAPIDS, IOWA.—The Cedar Rapids & Marion Telephone Company is considering the expenditure of $50,000 on extensions and improvements. C.

MOUNT VERNON, MO.—The Mount Vernon Telephone Company has been incorporated with a capital stock of $6,000, by J. M. Allen, Henry McCanse and others.

PETALUMA, CAL.—W. D. Thomas and others of this place are preparing to extend a rural telephone line along the Bloomfield Road three and one-half miles beyond Stony Point. A.

GRAYMONT, ILL.—The Home Creek Telephone Company has been incorporated with a capital stock of $1,500. The incorporators are Leonard I. Harris, Lewis Buland and Thomas Aakew. Z.

ADA, OKLA.—The Abbott Telephone Company has been incorporated with a capital stock of $1,000. The incorporators are Claude Chapman, Fred Blankenship and R. J. Ross, all of Ada. Z.

LITTLE ROCK, ARK.—R. S. Parker, president of the Arch Street Telephone Company, recently filed corporation papers. The service accommodates about fifty farmers along the Saline County line.

CENTER, IND.—The Center Telephone Company has been incorporated with a capital stock of $10,000 to operate a telephone exchange. The directors are John Ingels, W. H. Reynolds and Elmer Thomas. Z.

INDEPENDENCE, CAL.—The Owens Valley Improvement Company has asked for a franchise for a telephone system in the towns of Lone Pine and Independence in this county. The franchise asked for will be offered for sale on March 7. A.

STANWOOD, MICH.—The Grant and Green Townships Telephone Company has been organized with James Hull of Grant township as president. The Company is composed of many prominent farmers and the officers plan to give telephone service to practically every farmer in the townships.

MILWAUKEE, WIS.—A new exchange to take care of telephone subscribers in the northwestern section of Milwaukee, including the Washington park district, will be erected at the northeast corner of Twenty-eighth and Wright Streets as soon as weather permits, at a cost of $100,000.

MARSHALLTOWN, IOWA.—The Merchants, Mechanics and Farmers' Telephone Company, a new mutual organization that will oppose the Bell line, has announced its plans for starting the building of a new exchange and offices about March 1. The Company will install an automatic plant, and will invest $100,000.

GALVESTON, TEX.—Completing the last part of their work in the far northern section of the state, telephone linemen are now setting cedar posts and stringing copper wire across the unfenced cattle range, to link the system of the Southwestern Telegraph & Telephone Company with the system crossing the mountains of Colorado and New Mexico.

## ELECTRICAL SECURITIES.

Money is easier both here and abroad and the financial situation is even better than during the preceding week. Railway reports for last month were highly encouraging. The Harriman roads showed a radical turn from net decreases to increases. The business of the United States Steel Corporation for January exhibited a daily booking of 30,000 tons, exclusive of the rail orders placed by the New York Central and by the Pennsylvania Railways; a large increase over December and a considerable improvement over the corresponding time in 1910.

Judge Grosscup has authorized redemption of old Chicago Consolidated Traction receivership certificates, as follows: North Shore Electric Railway Company, $160,728; Chicago Electric Transit Company, $98,500; Cicero & Proviso Railway, $381,200; Ogden Street Railway Company, $49,772, and North Chicago Electric Railway Company, $160,728.

Practically all of the $1,500,000 ten-year six-per-cent convertible bonds of the Detroit Edison Company offered to the stockholders at par last December have been subscribed for. The amount not taken is stated to be very small. This issue was not underwritten. Of the company's $1,000,000 convertible debentures due September 1, all but $80,000 have been converted into stock. This conversion makes the amount of stock now outstanding about $5,920,000. The amount authorized is $9,000,000. Detroit Edison experienced a most prosperous period for the year ended December 31, 1910. Estimates place earnings at close to thirteen per cent on the stock. In 1909, 8.26 per cent was earned on the $5,000,000 stock then outstanding.

Earnings of the Massachusetts Electric Companies in January gained slightly less than $1,000 per day compared with $1,400 per day in December. The actual increases for the two months were $27,000 for January and $44,400 for December, which was, however, the best month of that quarter. The Massachusetts Electric Companies will spend during 1911 a total of approximately $950,000 in new construction. This is substantially $600,000 less than the previous year. In part, the decrease has been due to desire of the management to curtail expansion during a relatively poor trolley year. In part, also, it represents the fact that the demand for extension work is steadily becoming less urgent and may be expected to assume nominal proportions for the next few years.

### DIVIDENDS.

Federal Light & Traction Company regular quarterly dividend of one and one-half per cent on the preferred stock, payable March 1 to stock of record February 15.

Portland Railway, Light & Power Company; quarterly dividend of $1 per share, payable March 1.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

| | Feb. 6. | Jan. 30. |
|---|---|---|
| Allis-Chalmers common | 8⅜ | 7⅞ |
| Allis-Chalmers preferred | 33¼ | 31 |
| Amalgamated Copper | 66 | 62½ |
| American Tel. & Cable | 82 | 82 |
| American Tel. & Tel. | 146 | 144½ |
| Brooklyn Rapid Transit | 79⅛ | 77¼ |
| General Electric | 154 | 152 |
| Interborough-Metropolitan common | 19⅞ | 18½ |
| Interborough-Metropolitan preferred | 54¼ | 53⅛ |
| Kings County Electric | 123 | 123 |
| Mackay Companies (Postal Telegraph and Cables) common | 93¾ | 90 |
| Mackay Companies (Postal Telegraph and Cables) prefd | 75¾ | 74½ |
| Manhattan Elevated | 138 | 138 |
| Metropolitan Street Railway | *18 | *18 |
| New York & New Jersey Telephone | 103 | 103 |
| Pacific Tel. & Tel. | 53¼ | 53½ |
| U. S. Steel common | 81½ | 78⅝ |
| U. S. Steel preferred | 120¾ | 119¼ |
| Western Union | 74¾ | 74½ |
| Westinghose common | 63 | 66 |
| Westinghouse preferred | 116 | 116 |

*Last price quoted.

BOSTON.

| | Feb. 6. | Jan. 30. |
|---|---|---|
| American Tel. & Tel. | 146¼ | 144 |
| Edison Elec. Illuminating | 291 | 290 |
| General Electric | 154 | 151½ |
| Massachusetts Electric common | 18 | 17½ |
| Massachusetts Electric preferred | 87 | 85 |
| New England Telephone | 140 | 137 |
| Western Tel. & Tel. common | 22½ | 18½ |
| Western Tel & Tel. preferred | 93 | 90½ |

PHILADELPHIA.

| | Feb. 6. | Jan. 30. |
|---|---|---|
| American Railways | 44¼ | 45 |
| Electric Company of America | 12⅛ | 12⅛ |
| Electric Storage Battern common | 54½ | 53½ |
| Electric Storage Battery preferred | 54½ | 53½ |
| Philadelphia Electric | 16⅝ | 16⅛ |
| Philadelphia Rapid Transit | 20⅞ | 20¼ |
| Philadelphia Traction | 86½ | 86½ |
| Union Traction | 47⅝ | 47⅝ |

CHICAGO.

| | Feb. 6. | Jan. 30. |
|---|---|---|
| Chicago Railways, Series 1 | 90 | 90 |
| Chicago Railways, Series 2 | 25 | 24½ |
| Chicago Subway | 4 | 4 |
| Chicago Telephone | 119 | 118 |
| Commonwealth Edison | 114 | 113 |
| Metropolitan Elevated common | 20½ | 21 |
| Metropolitan Elevated preferred | 65 | 66½ |

## PERSONAL MENTION.

S. J. DILL was elected second vice-president of the Susquehanna Railway, Light & Power Company at a recent meeting of the board of directors.

R. G. HUTCHINS has been elected vice-president of the Chicago Railways Company. He will perform executive duties in the capacity of assistant to Chairman Blair.

C. R. BLANKENSHIP has been appointed superintendent for the Home Telephone Company at Mound City, Ill., succeeding W. T. Friganza, who goes to a similar position at Vienna, Ill.

J. P. CASEY, formerly sales manager of the Commercial Electrical Supply Company, St. Louis, Mo., has accepted the position of sales manager of the Moloney Electric Company, St. Louis.

GEORGE M. BENNETT, of Urbana, Ill., has been elected president of the Kankakee, Urbana & Charleston Traction Company, organized to build an electric line from Kankakee to Charleston.

T. E. RUST, of Waterloo, Iowa, chief engineer for the Waterloo, Cedar Falls & Northern Railway, has been made consulting engineer to succeed the late M. L. Newton, the positions having been combined.

EDWARD H. TENNEY, assistant to the chief engineer of the Union Electric Light & Power Company of St. Louis, Mo., read a paper on "Economical Generation in the Modern Central Station," before the Engineers' Club of St. Louis, on February 1.

W. H. THOMSON, JR., of St. Louis, has been appointed senior operating engineer of the Illinois Traction System and the Western Railways and Light Company, with headquarters at Peoria, Ill. He will have charge of all the electric and gas properties in Illinois, Missouri, Iowa and Kansas.

C. A. TUPPER, of the Alliance Engineering & Sales Company, Milwaukee, Wis., has sailed on the *Romanic* for Mediterranean ports and a trip through Italy, Austro-Hungary, Germany, England, Holland, Belgium, Switzerland, France and Spain in the interest of his various business connections. Mrs. Tupper and son Ellis accompany him.

EDWIN W. WINTER, after eight years of service as president of the Brooklyn Rapid Transit Company, has withdrawn as a director of the company and announced his intention to retire from the presidency. Mr. Winter went with the company in 1903 to do reorganization work which, it was estimated, would not take longer than a year. Mr. Winter will be succeeded by T. S. Williams.

## OBITUARY.

EDWARD ST. JOHN, assistant treasurer of the Westinghouse Electric & Manufacturing Company, died suddenly on February 2.

HAWTHORNE HILL, associate editor of the *India Rubber World*, died at his home on February 2. He is survived by a widow and three children.

JARVIS BONESTEEL EDSON, who was active in the affairs of the National Electric Light Association during the first ten years of its existence, and who was the inventor of a number of mechanical devices, died on January 26 in New York City. Mr. Edson was a member of the American Society of Mechanical Engineers, the American Society of Naval Architects and Marine Engineers, the Engineers' Club, and a number of other bodies. He was, at the time of his death, sixty-six years old.

F. A. KJELLIN, the inventor of the induction furnace for melting and refining steel, died suddenly on December 30, 1910, at the age of thirty-eight years. He was born near Stockholm, Sweden, and was educated in the Royal Technical Institute of that city, from which he graduated in 1903. After graduation he turned his attention to experimental work connected with chemistry and metallurgy and patented a new method for electrolytic precipitation of zinc. Dr. Kjellin was for some time chief of the electrometallurgical department of the Swedish Gröndal-Kjellin Company, and was later consulting engineer for that department.

## NEW PUBLICATIONS.

MAGNETIC TESTING.—The Bureau of Standards has issued the second edition of Bulletin No. 17, dealing with the above-named subject. A description of the nature of the work is given and its scope, together with some of the results obtained. Directions to those wishing to have specimens of metal tested are included in the bulletin. A list of papers, dealing with magnetic subjects, which have been published by the Bureau, is given in order that those interested may secure the printed publications.

ELECTRICAL ENGINEERING ABSTRACTS, published by the International Institute of Technical Bibliography, 57-58 Chancery Lane, London, W. C., includes abstracts of all books and articles dealing with engineering and technical science. Each item gives the full title and name of the author, title and date of publication, and a brief resumé of the article. The publication, although new, this being the first volume, is already recognized as a comprehensive authority in its field. E. Wyndham Hulme, chief librarian of the English Patent Office, wrote an article of appreciation regarding the publications of the Institute, which appeared in the August issue of the *Library Association Record*.

## NEW INCORPORATIONS.

KNOXVILLE, TENN.—The Henry M. Moses Electric Company has been incorporated with a capital of $5,000. P.

CINCINNATI, O.—The Paul Stewart Company has been incorporated with a capital stock of $50,000 to deal in steam and electrical appliances. The incorporators are George W. Gano, Paul Stewart, Ainslee T. Carter, Colter Rule and Henry J. Schutte.

DULUTH, MINN.—The Electric Service & Repair Company has incorporated with a capital stock of $25,000 to do a general electrical and mechanical repair and fitting business. The incorporators are John Smith, George A. Parker, and Robert H. Long.

MANHEIM, PA.—The Manheim Manufacturing & Belting Company has been incorporated by local capitalists to manufacture the Veelos Balata belt. The officers of the company are: President, Charles Bond; vice-president, George H. Danner; secretary, M. M. Pfantz, and treasurer, M. G. Hess.

DETROIT, MICH.—The Durango Commercial Company has been incorporated to exploit the rubber from a new source of supply discovered in Mexico by Prof. John R. Allen of the University of Michigan. Those interested in the idea are practically all Detroit men. Officers of the Company have been chosen as follows: Joseph H. Hunter, president; Henry W. Campbell, vice-president; John R. Allen, secretary; Herbert W. Noble, treasurer; J. W. Thompson and E. E. Keller, with the others, constitute the directors.

## PROPOSALS.

HOSPITAL, FORT MISSOULA, MONT.—Sealed proposals for electric wiring and fixtures for the hospital at Fort Missoula, Mont., will be received until February 28. Bids should be sent to Lieut. Roy W. Winton, Fort Missoula. Z.

WIRING SCHOOL, FREEPORT, ILL.—Sealed proposals will be received until February 21 for electric wiring and bells and lighting-fixtures for grammar school building at Freeport, Ill. Plans are with C. F. Hildreth, chairman Building Committee, Freeport, or Patton & Miller, 140 Dearborn Street, Chicago, Ill., architects. Z.

POST OFFICE, ROSWELL, N. M.—The office of the Supervising Architect, Washington, D. C., announces that the time for opening bids for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring), of the United States post office and court house at Roswell, N. M., has been extended from February 2 to February 23.

POST OFFICE, MURPHYSBORO, ILL.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until February 23 for the construction, complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States post office at Murphysboro, Ill., in accordance with drawings and specification, copies of which may be obtained from the custodian of site or at the Supervising Architect's office, Washington, D. C.

POST OFFICE, BIG STONE GAP, VA.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until February 20, for the construction, complete, (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the United States post office and court house at Big Stone Gap, Va., in accordance with drawings and specifications, copies of which may be obtained from the custodian of site or at the Supervising Architect's office.

POST OFFICE, BROOKHAVEN, MISS.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until March 8, 1911, for the construction, complete (including plumbing, gas-piping, heating apparatus, electric conduits and wiring), of the United States post office at Brookhaven, Miss., in accordance with the drawings and specification, copies of which may be obtained from the Custodian of site at Brookhaven, Miss., or at the Supervising Architect's office.

POST OFFICE, NORTH YAKIMA, WASH.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until February 18 for the construction (complete), except elevator, but including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States post office at North Yakima, Wash., in accordance with drawings and specifications, copies of which may be obtained from the custodian of site at North Yakima or at the Supervising Architect's office.

NAVY DEPARTMENT SUPPLIES.—The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will open bids on naval supplies on the dates given below. Bidders interested therein should make early application for copies of the schedule, giving the schedule numbers desired. Schedules can be obtained from the Navy Pay Office nearest each navy yard. Bids will be asked on the following supplies:

| Date of Opening. | Material. | Quantity. | Place of Delivery. | Schedule Number. |
|---|---|---|---|---|
| February 21— | Boxes, feeder junction | 80 | Brooklyn, N. Y. | 3331 |
| | Cable, interior communication | 22,000 feet | Brooklyn, N. Y. | 3331 |
| | Cord, telephone | 20,000 feet | Brooklyn, N. Y. | 3331 |
| | Wire, bell | 100,000 feet | Brooklyn, N. Y. | 3331 |
| | Wire, single conductor | 35,000 feet | Brooklyn, N. Y. | 3331 |
| | Wire, twin conductor | 155,000 feet | Brooklyn, N. Y. | 3331 |

## LEGAL NOTES.

INTERURBAN LEGISLATION.—A bill has been introduced in the legislature of Indiana requiring all interurban roads to make certain that all motormen employed have had at least one year's experience. Another bill introduced in the Indiana Legislature relates to increasing the power of the Commission in dealing with interurban roads concerning block-signal systems.

BILL ON RIGHTS OF WAY.—Senator Dixon has reported back with amendments the bill authorizing the Secretary of the Interior to grant an easement for rights of way for a period of fifty years over and across public lands, national forests and reservations for electrical poles and lines for the transmission and distribution of electrical power and for poles and lines for telephone and telegraph purposes from fifty to ten feet on each side of the center line of such electric, telephone and telegraph lines and poles. F.

WATERPOWER LEGISLATION IN TEXAS.—The importance of utilizing the water of the different streams of Texas for the operation of hydroelectric plants will receive attention at the hands of the present legislature. Sen. F. C. Weinert and Rep. H. C. Donegan, both of Seguin, have jointly prepared a bill giving to towns and cities of the state the right of condemnation for the purpose of constructing dams and erecting hydroelectric plants. Besides this general bill, Senator Weinert has prepared a special measure providing for the construction of a dam and hydroelectric plant at any point on the Guadalupe River within twelve miles in either direction from the town of New Braunfels. The most favorable point is considered to be just below the junction of the Comal and Guadalupe Rivers, so as to utilize the water from both streams. The construction will not interfere with any plants or power already developed by private enterprises. D.

PUBLIC SERVICE COMPANY CANNOT BE BANKRUPT.—The action of the United States District Court, of New York, in dismissing three petitions of public service corporations for involuntary bankruptcy, has been sustained by the United States Circuit Court of Appeals. The three companies concerned were: The Saratoga Gas, Electric Light & Power Company, The Hudson River Electric Company, and The Hudson River Power Transportation Company. The grounds on which these applications were primarily denied were that such bankruptcy would be contrary to the bankrupt act of 1898. Judge Lacombe of the higher court stated in his decision that the duty of the public service corporations was first to the public and later to the creditors and that conditions were materially different from those existing in the case of a manufacturing company. In closing, he further stated: "So far as we can ascertain no corporation engaged in rendering public service has been made an involuntary bankrupt, which may be some indication of the general understanding as to the scope of Section 4 of the bankrupt act. We are of the opinion that Congress has not intended to include corporations such as these now before us in the enumeration of that section, either as it originally stood or as it was amended in 1903."

## INDUSTRIAL ITEMS.

THE McROY CLAY WORKS, Chicago, Ill., has mailed advertising blotters and calendars for the month of February.

THE OTIS ELEVATOR COMPANY, New York, N. Y., includes an illustrated article on the Catskill Mountain Incline Railway in its January issue of *The Indicator*.

THE F. W. WAKEFIELD BRASS COMPANY, Vermillion, Iowa, illustrates in a recent folder a number of attractively designed Wakefield fixtures for Mazda lamps.

THE AMERICAN CIRCULAR LOOM COMPANY, New York, N. Y., has mailed decorative folders advertising "X Duct." This galvanized conduit has a double coating of copper and zinc.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., has issued its February number of "Graphite." A number of articles on graphite paint and graphite for lubricating purposes are included.

THE PARAGON SELLERS COMPANY, Chicago, Ill., has issued a new bulletin on grounding. The manufacturers state that sales of the Paragon ground cone to telephone companies both in this country and Canada indicate that it is being adopted as a standard grounding device very generally.

THE DE LAVAL STEAM TURBINE COMPANY, Trenton, N. J., has published a very complete commercial exposition of the steam turbine in a recent bulletin. The work is devoted to single-phase turbines but numerous questions connected with available energy and steam, etc., are also touched upon.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, O., recently distributed Bulletin No. 451 on Triumph transformers for power and lighting. The construction and features of the transformer are described, and a number of illustrations of the transformer both assembled and in part are shown.

ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has published Bulletin No. 1510 on Allis-Chalmers direct-connected Reynolds Corliss engines. Some points on direct-connected vs. belt-driven units are given, and the information required in making estimates is included for the convenience of the possible purchaser.

THE SPRAGUE ELECTRIC COMPANY, New York, N. Y., recently issued Catalog No. 436 on its Sprague conduit products. The parts listed are illustrated and described and the prices given throughout. The company is also sending out bulletin No. 111 in which is included a partial list of installations of engine type generators.

THE HACKNEY ELECTRIC VENTILATING COMPANY, St. Paul, Minn., has published a booklet on the value of ventilating. The booklet contains illustrations of a Hackney ventilating set and a considerable amount of interesting information on the subject. At the same time the Company is mailing a number of letters of recommendation written by its customers.

THE EMERSON ELECTRIC COMPANY, St. Louis, Mo., is placing on the market the Semco vacuum cleaner, manufactured by the Semco Vacuum Cleaner Company, of Nashville, Tenn. The cleaners are made to combine lightness, efficiency and durability, and are constructed entirely of aluminum. The parts of the cleaner are illustrated in the January number of *The Emerson Monthly*.

THE GARWOOD ELECTRIC COMPANY, New York, N. Y., announces the appointment of Henry Widmer, 731 Union Street, New Orleans, La., as agent for the sale of its product in Louisiana, the southern half of Mississippi, the city of Mobile, Ala., and all territory within a radius of fifty miles of the city. Milton S. Nettleton has been appointed agent for the company in the city of New Haven and the surrounding territory.

THE WESTERN ELECTRIC COMPANY, New York, N. Y., is distributing its 1911 fan-motor bulletin. This bulletin lists "Hawthorn" fan motors under the following heads: Desk and bracket, oscillating, residence, telephone booth, battery, ceiling and column fan motors and ventilating outfits. Illustrations and tables of prices are given for each type. A copy of this bulletin will be forwarded upon request addressed to any of the Western Electric houses.

THE BANNER ELECTRIC COMPANY, Youngstown, O., describes the magnificent new Allegheny County Soldiers' Memorial at Pittsburg, Pa., in a recent booklet. The publication is attractively prepared and will be of especial interest to electrical and illuminating engineers, owing to the fact that the edifice is considered by many to be the best example of artificial illumination in the world. Aside from the publication being well bound and attractively printed, it contains seven colored illustrations.

THE COMMERCIAL BUREAU COMPANY, New York, N. Y., has, in its rooms in the Hudson Terminal Building, complete reference catalogs, free reading rooms and offices where out-of-town manufacturers may keep business appointments. The library of manufacturers' catalogs in the Manufacturers' Library contains several thousand catalogs, each one of which may be found in a very short time through a convenient card index. Business men visiting New York are invited to make the Library their down-town headquarters, and to make use of the telephone, telegraph and stenographic service furnished.

THE SANGAMO ELECTRIC COMPANY, Springfield, Ill., is distributing Bulletin No. 22 describing its portable and switchboard-type graphic recorders. Several pages are devoted to a discussion of the application of graphic recorders to soliciting power, checking input of electrically-driven machines, etc. It is also distributing an attractive booklet entitled. "The Ampere Hour Meter For Electric Vehicles." Considerable information is given as to the proper method of charging both commercial and pleasure vehicles. This should be of much interest to central station managers, who are soliciting charging loads.

THE WESTERN ELECTRIC COMPANY has issued Bulletin No. 9465 describing the Moore light for color matching. This lamp is declared to be the only artificial illuminant whih gives exact daylight color values, and it is being introduced into shops, mills and other establishments where color values are of great importance. The white Moore light is a radically new form of the electric light. It is a vacuum-tube electric light produced by the passing of alternating currents through highly rarefied carbon-dioxide gas confined within a continuous clear glass tube. The bulletin contains a description of this illuminant and of its uses and operation. A page is devoted to the list of concerns now using it, and another to tabulated dimensions, data, etc.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has sold the Isthmian Canal Commission two seventy-five-kilowatt motor-generator sets with a switchboard for the control of each. One of the motor-generator sets will be located in the substation near the site of the Gatun locks and the other on the Pacific side near the Pedro Miguel locks. The apparatus will be used in connection with the construction of the lock gates. The outfits will be installed at Gatun and Pedro Miguel and will operate on twenty-five-cycle, 2300-volt energy transmitted from the power stations at Gatun and Miraflores. The motor-generators will convert this alternating current to direct current at 230 volts for use on the various small tools used in the gate construction.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued a number of bulletins on various subjects, but mostly relating to the subject of power and power machinery. Bulletin 4685 describes revolving-field alternators ranging in capacity from thirty to 550 kilowatts. The bulletin contains dimensioned diagrams of the complete line. Bulletin 4784 is devoted to electric drive in pulp and paper mills. The advantages to be derived from the use of electric power in this industry are set forth and descriptions of a number of important installations are included. Wood-working plants in connection with electric drive are dealt with in Bulletin 4785. The bulletin illustrates and describes the electric motor as a part of wood-boring machines, drills, jig saws, rip saws, band, circular and swing saws, planers, etc. The publication should be of interest to all in this business. The subject of voltage regulators is taken up in Bulletin 4793, which is entitled "Steady vs. Unsteady Voltage." This publication illustrates and describes regulators for controlling the generator voltage and also those for regulating the feeder voltage. There are reproductions of curves showing voltage with and without regulators installed. The bulletin illustrates installations of both types of regulators. Straight-airbrake equipment to meet the requirements of modern electric railway service is described in Bulletin No. 4798.

### DATES AHEAD.

Philadelphia Electric Show, Philadelphia, Pa., February 13-27.

American Institute of Electrical Engineers, Mid-year Convention, Schenectady, N. Y., and Pittsfield, Mass., February 14, 15 and 16.

Electric Jobbers' Association, French Lick Springs, Ind., February 15, 16 and 17.

American Physical Society. Next regular meeting, New York City, March 4, 1911.

Minnesota Electrical Association. Annual convention, St. Paul Hotel, St. Paul, Minn., March 14, 15 and 16.

American Supply and Machinery Manufacturers' Association. Annual meeting, Louisville, Ky., April 3, 4 and 5.

Missouri Electric, Gas, Street Railway and Water Works Association. Annual meeting, St. Louis, Mo., April 13, 14 and 15.

Iowa Electrical Association. Annual meeting, Davenport, Iowa, April 19, 20 and 21.

Southwestern Electrical & Gas Association. Annual convention, Houston, Tex., April 27-29.

Mississippi Electric Association. Annual convention, Gulfport, Miss., June 20-21.

# Directory of Electrical and Allied Engineering and Scientific Societies

**(Published in the second issue of each month.)**

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary, G. S. Emery, Mobile, Ala.

AMERICAN ASSOCIATION OF ELECTRIC MOTOR MANUFACTURERS. Secretary, W. H. Tapley, 29 West Thirty-ninth Street, New York, N. Y.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Secretary, L. O. Howard, Smithsonian Institution, Washington, D. C.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, H. C. Donecker, 29 West Thirty-ninth Street, New York, N. Y. Affiliated societies: American Electric Railway Accountants' Association, secretary, H. E. Weeks, Davenport, Iowa; American Electric Railway Claim Agents' Association, secretary, B. B. Davis, Columbus Railway & Light Company, Columbus, O.; American Electric Railway Engineering Association, secretary, Norman Litchfield, New York, N. Y.; American Electric Railway Transportation and Traffic Association, secretary, H. C. Donecker, 29 West Thirty-ninth Street, New York, N. Y.; American Electric Railway Manufacturers' Association, secretary, George R. Keegan, 2321 Park Row Building, New York, N. Y.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, J. W. Richards, South Bethlehem, Pa.

AMERICAN ELECTROTHERAPEUTIC ASSOCIATION. Secretary, John Travell, 17 East Eleventh Street, New York, N. Y.

AMERICAN FOUNDRYMEN'S ASSOCIATION. Secretary, Richard Moldenke, Watchung, N. J.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. Secretary, John C. Olsen, Polytechnic Institute, Brooklyn, N. Y.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 29 West Thirty-ninth Street, New York, N. Y.

AMERICAN INSTITUTE OF MINING ENGINEERS. Secretary, Rossiter W. Raymond, 29 West Thirty-ninth Street, New York, N. Y.

AMERICAN IRON AND STEEL INSTITUTE. Secretary, W. J. Filbert, 30 Church Street, New York, N. Y.
AMERICAN MATHEMATICAL SOCIETY. Secretary, F. N. Cole, 50 West One-Hundredth-and-Sixteenth Street, New York, N. Y.
AMERICAN PHYSICAL SOCIETY. Secretary, Ernest Merritt, Cornell University, Ithaca, N. Y.
AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Secretary, J. W. Taylor, Old Colony Building, Chicago, Ill.
AMERICAN ROENTGEN-RAY SOCIETY. Secretary, G. C. Johnson, 514 Bijou Building, Pittsburg, Pa.
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# RECORD OF ELECTRICAL PATENTS.

**Issued (United States Patent Office) January 31, 1911.**

982,784. DYNAMO-ELECTRIC MACHINE. Bernard A. Behrend and Allan B. Field, Pittsburg, Pa., assignors to Allis-Chalmers Company and Bullock Electric Manufacturing Company. Filed October 28, 1909. The rotor core has a smaller diameter at the middle than at the ends, consequently the air gap is smallest at the edges of the core.

982,789. ELECTROMAGNETIC POWER-TRANSMITTING MECHANISM. Augustus Jesse Bowie, Jr., San Francisco, Cal. Filed April 18, 1907. A magnetic clutch in which a slotted electrical conductor is interposed in an air gap in the magnetic circuit.

982,794. AUTOMATIC CONTROLLING MECHANISM FOR REFRIGERATING SYSTEMS. Eugene Carpenter, Newton, and Fred M. Kimball, Somerville, Mass., assignors to Automatic Refrigerating Company, Jersey City, N. J. Original application filed March 15, 1907. Divided and this application filed August 21, 1907. A pressure-governed motor-controlling switch is adapted to be automatically opened from a number of positions.

982,800. ELECTRIC REGULATION. John L. Creveling, New York, N. Y., assignor to Safety Car Heating and Lighting Company. Filed February 2, 1909. In an axle car-lighting equipment there is an automatic regulator throwing resistance in the lamp circuit when the storage-battery voltage rises.

982,806. DYNAMO-ELECTRIC MACHINE. Carl J. Fechheimer, Milwaukee, Wis., assignor to Allis-Chalmers Company. Filed May 13, 1909. The end portions of the rotor core are of greater diameter than the intermediate portion, are contiguous with the latter near the center, and are separated therefrom near the periphery by gaps or spaces of high reluctance.

982,809. AUTOMATIC HOIST. Guy C. Grable, Minneapolis, Minn., assignor to Nelson F. Dunn, Minneapolis, Minn. Filed April 18, 1907. An electric hoist with two cars is driven by a reversible motor, which is automatically started and stopped.

982,811. DYNAMO-ELECTRIC MACHINE. Alexander M. Gray, Milwaukee, Wis., assignor to Allis-Chalmers Company. Filed April 3, 1909. The rotor coils project beyond the ends of the core. There are means formed of magnetic material for protecting and holding in position the projecting portions of the coils. The clearance between the stator and rotor cores is equal at the two ends of the machine, and uniform and of greater width throughout the middle portion of the machine.

982,813. DYNAMO-ELECTRIC MACHINE. David Hall, Norwood, Ohio, assignor to Bullock Electric Manufacturing Company. Filed January 15, 1906. A double-commutator machine has two distributed balancing coils for neutralizing the armature reaction, one coil being in series with the brushes of each commutator.

982,814. ELECTRICAL MUSIC-PLAYER. David J. Hauss, Aurora, Ind. Filed December 2, 1909. Associated with a music sheet are electrical contact fingers arranged in plural series with the respective series of fingers differently spaced, and a contact member adapted to bring the sheet into operative relation with the desired series of contact fingers.

982,822. AUTOMATIC FIRE-DETECTOR. Roy Y. Hughes and Louis J. Hoffmann, Aberdeen, S. D. Filed July 30, 1909. A thermo-responsive circuit-controller comprises an elongated member having at each end a pair of adjacent circuit terminals and within the elongated member a mass of mercury and a fusible plug, these occupying less than the internal capacity of the elongated member.

982,823. MEANS FOR ILLUMINATING INTERIORS OF BUILDINGS. James J. Jennings, Chicago, Ill. Filed December 31, 1909. A trough-shaped reflector has a base plate connected with a horizontal hollow socket and a series of reflecting plates connected with the base plate.

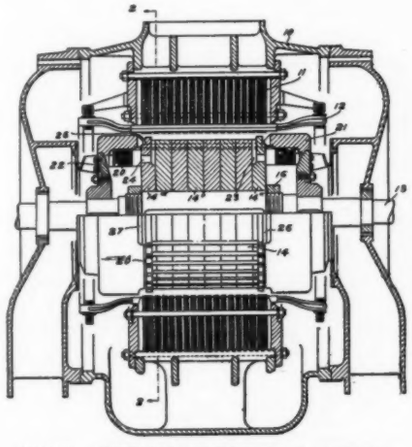
982,830. DYNAMO-ELECTRIC MACHINE. Albert Kingsbury, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. Filed March 4, 1907. A turbo-alternator is inclosed in a casing having definite channels for air to be drawn in near the shaft, then past the end connections and through the rotor and stator and finally forced out of the exhaust ports at the bottom of the casing.

982,831. THERMO-ELECTRIC COOKER. Robert S. Kirkpatrick, Des Moines, Iowa. Filed March 11, 1908. Contains an electric heating coil at the bottom of the chamber, all being inclosed by a heat-insulating lining through which a pyrometer passes.

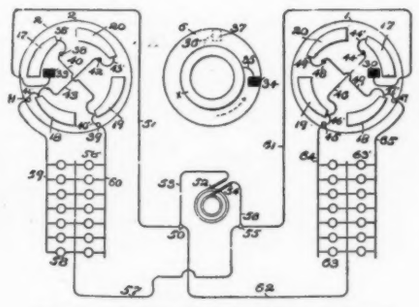
982,839. SIGNALING MECHANISM. Hugh Macdonald, Ann Arbor, Mich. Filed March 24, 1910. A clock dial carries an adjustable contact point adapted to engage either of the hands and thus to close an alarm circuit.

982,841. SWITCH BOX OR RECEPTACLE. Cyril Charles Maison, Cleveland, Ohio, assignor to Economy Switch Box & Manufacturing Company. Filed February 15, 1910. Is provided with sustaining ears for securing the box in place.

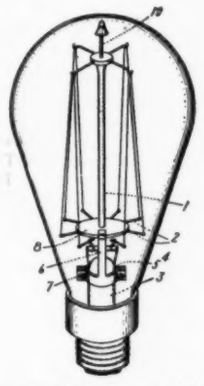
982,869. ELECTRIC SWITCH. William T. Pringle, Philadelphia, Pa. Filed April 7, 1909. A quick-acting knife switch is controlled by an operating lever biased to either open or closed positions.



982,806.—DYNAMO ELECTRIC MACHINE.



982,872.—ELECTRIC LIGHTING SYSTEM.



982,873.—FILAMENT CONNECTION.

982,872. ELECTRIC-LIGHTING SYSTEM. Frederick W. Reeves, Pittsburg, Pa. Filed August 23, 1909. A sign-flashing system includes an interrupter with alternate live and dead segments.

982,873. CURRENT-CONDUCTOR. Jakob Regenstreif, Berlin, Germany, assignor to General Electric Company. Filed June 2, 1910. The filament spider of an incandescent lamp is connected to the stem by a collar clasping the stem and supports extending from the collar to the spider.

982,883. APPARATUS FOR HANDLING MAGNETIC MATERIALS. James F. Schnabel, Cleveland, Ohio, assignor to Electric Controller & Manufacturing Company, Cleveland, Ohio. Filed April 22, 1910. A lifting magnet is arranged to be moved on a traveling crane so as to bring it into alinement with a receptacle.

982,897. MOTOR-CONTROL SYSTEM. Emmett W. Stull, Norwood, Ohio, assignor to Allis-Chalmers Company. Filed April 10, 1908. A railway motor controller is pneumatically controlled by air from a reservoir auxiliary to the main air-brake reservoir.

982,913. APPARATUS FOR CONTROLLING ELECTRIC MOTORS. George H. Whittingham, Pikesville, Md., assignor to Monitor Manufacturing Company. Filed May 31, 1910. Consists of a main switch and electromagnetic switches for regulating the resistance of the motor circuit.

982,930. ELECTRIC SIGNALING DEVICE. Donald M. Bliss, New York, N. Y. Filed March 18, 1907. Directly connected to a motor shaft are several commutators whose segments are connected through resistances; brushes carry the current through transformers to the external signaling circuits.

982,938. ELECTRIC CASH-REGISTER. Joseph P. Cleal, Toronto, Ontario, Canada, assignor to National Cash Register Company, Dayton, Ohio. Filed March 20, 1909. A type wheel is rotated under the control of a set of electromagnets actuated by the keys of a keyboard.

983,029. MAGNETO-ELECTRIC MACHINE. William W. Dean, Elyria, Ohio, assignor to Dean Electric Company. Original application filed January 28, 1910. Divided and this application filed October 20, 1910. A permanent horseshoe magnet is permanently mounted on a grooved metallic base plate.

983,039. INSULATOR-PROTECTOR. John E. Field, Gains, Mich. Filed February 17, 1910. The protector is constructed of a single blank including a neck to overlie the upper end of the insulator and closing section to envelop the insulator below the upper end, the neck being formed to provide a loop for the passage of a wire.

983,043. METHOD OF SUPPLYING ELECTRIC FURNACES WITH POLYPHASE CURRENTS. Paul Girod, Ugine, France. Filed August 24, 1910. Comprises a furnace having a lower electrode and a pair of upper electrodes held out of contact with the fused metal, a three-phase system of supply, a pair of single-phase transformers having their primaries connected to different phases of the system and their secondaries connected to the electrodes, the terminals of the transformers being relatively inverted and the secondary terminals being connected to the electrodes in such order that the greater potential difference resulting from such inversion exists between the two upper electrodes.

983,062. STORAGE-BATTERY ELECTRODE. Pierre J. Kamperdyk, New York, N. Y. Filed December 6, 1909. A number of porous cups are located between the ribs of the electrode. These cups are provided with edge ribs on all their sides, corrugated faces and longitudinal ribs and are filled with an active material at the side adjacent to the conducting plate.

983,063. MOTOR-CONTROLLING SWITCH. Samuel H. Keefer, Plainfield, N. J., assignor to Niles-Bement-Pond Company, Jersey City, N. J. Filed November 8, 1909. A motor-controlling switch consists of a solenoid, two contacts carried by the movable member of the solenoid, two fixed contacts placed to be respectively engaged by the solenoid contacts when the solenoid is de-energized, and two other fixed contacts placed to be successively engaged by the solenoid contacts after the solenoid has been energized.

983,098. TELEPHONE SYSTEM. Frank C. Unger, St. Louis, Mo. Filed November 1, 1909. Comprises a generating machine located at the central office, line drops, a clearing-out drop and local batteries. Means are provided for completing a circuit through the generating machine and one of the line-drops when a subscriber answers a call and for completing a circuit through the clearing-out drop and the generating machine when the subscriber completes his conversation.

983,113. APPARATUS FOR LIGHTING LAMPS. Elmer Barber, Philadelphia, Pa. Filed February 23, 1910. A switch with an oscillating shaft mounted on the crossbar.

983,139. MANUFACTURE OF FILAMENTS, FILM, AND OTHER CELLULOSE PRODUCTS FROM CELLULOSE SOLUTIONS. Rudolf Hömberg, Charlottenburg, Germany. Filed August 20, 1910. The process consists in adding to the solutions an aldehyde and then treating them further in the usual manner.

983,158. DYNAMO-MOUNTING. James F. McElroy, Albany, N. Y., assignor to United States Light & Heating Company, New York, N. Y. Filed February 21, 1908. Means are provided for securing constant belt tension in a dynamo run from a car axle.

983,161. ELECTRIC CONDUCTOR. Everett Morss, Boston, Mass., assignor to Simplex Electrical Co., Boston, Mass. Filed January 17, 1910. A longitudinal thread is woven in the braided covering, so as to provide an easy means of cable identification.

983,162. ELECTRIC WALL-BOX. Michael Murray and John D. MacDougal, Chicago, Ill., assignors to Federal Electric Company, Chicago, Ill. Filed January 25, 1909. A metal outlet box with a slidable panel.

983,175. ELECTRIC PRIMARY BATTERY. Frederick W. Spanutius, Jersey City, N. J. Assignor to Halsey Electric Generator

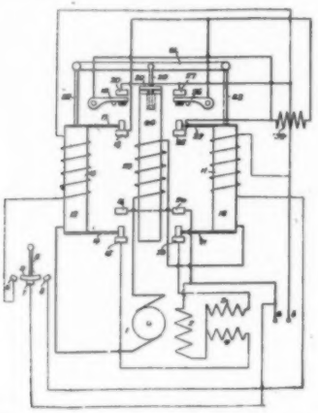
Co., Jersey City, N. J. Filed March 21, 1905. Comprises a plurality of cells connected in series and each having a movable and a fixed element, the series connections between the cells being fixed relatively to the elements which they connect.

983,178. ELECTRIC CUT-OFF. William Nelson Sturgeon and Henry Richard Shanley, Galesburg, Ill. Filed April 29, 1910. A spring attached to the key shank of an electric lamp socket eliminates the snap of the key at the same time insuring positive contact.

983,191. ELECTRIC SIGNAL SYSTEM. Frank B. Wood, New York, N. Y. Filed July 6, 1908. Combines a series of signal-transmitting mechanisms, locking devices for the transmitting mechanisms, an unlocking magnet for each of the transmitting mechanisms, an unlocking circuit, and means for operatively including but one of the electromagnets in the unlocking circuit at a time.

983,224. AUTOMATIC ELECTRIC TIME-SWITCH. Benjamin Franklin Flegel, Warren, O., assignor of one-half to Herbert D. Gunlefinger, Warren, O. The device includes and combines an electric switch, a power mechanism for actuating the switch comprising a drum, a spring, a winding arbor for the spring independent of the drum and in axial alinement with the switch arbor, connections between the drum and the switch comprising a block secured axially to the drum and having at one end a non-circular portion, a like block on the arbor of the switch, and a coupling sleeve receiving both blocks, and a release mechanism for the drum controlled by the time mechanism.

983,230. DYNAMO-BRUSH HOLDER. Otto Höhme, Radebeul, Germany. Filed November 17, 1909. A hollow arm is telescopically



983,065.—MOTOR CONTROLLING SWITCH.

mounted on the brush holder. A spring holds the brush in the brush box.

983,240. TELEGRAPH SYSTEM. Isidor Kitsee, Philadelphia, Pa. Filed February 1, 1909. The method consists in impressing a current upon a line, causing the current to gradually rise, then to diminish rapidly, and deriving from the line current a signal reproducing current.

983,241. REFLECTOR. Peter Kleber, Wiesbaden, Germany, assignor of one-half to Henry Zirwas, Yonkers, N. Y. Filed January 22, 1910. A glass reflector has its outer surface formed of zones substantially parallel to the source of light alternating with zones inclined to the light source at substantially the angle of total reflection.

983,245. ELECTRIC APPARATUS. Carl A. Lohr, Chicago, Ill. Filed February 11, 1908. A liquid conductor is placed in an evacuated space, and means are provided for setting the liquid conductor in rotation so as to cause a deformation by action of centrifugal force. An electric circuit is arranged so as to be interrupted in the evacuated space by the defomation and so as to start an electric arc at the point of interruption.

983,258. CONNECTOR FOR ELECTRIC CONDUCTORS. William Lord Bliss, Brooklyn, N. Y., assignor to United States Light & Heating Company, New York, N. Y. Filed August 27, 1907. Sockets are provided in one connector for a plurality of conductors.

## PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired February 6, 1911:

513,982. ELECTRIC CONDUCTOR. Horace F. Chick, Watertown, Mass.

514,019. CIRCUIT CONTROLLER. Edward J. McEvoy, New York, N. Y.

514,037. RAILWAY SWITCH. Augustin F. Schinner, Milwaukee, Wis.

514,047. DYNAMO AND MOTOR. Montgomery Waddell, Bridgeport, Conn.

514,056. CONDUIT ELECTRIC RAILWAY. Rufus C. Beardsley, Lafayette, Ind.

514,057. HOOD FOR ELECTRIC-ARC LAMPS. Sigmund Bergmann, New York, N. Y.

514,058. ELECTRIC-ARC LIGHT FIXTURE. Sigmund Bergmann, New York, N. Y.

514,075. ELECTRICAL MEASURING OR INDICATING INSTRUMENT. Samuel E. Hitt, Rockford, Ill.

514,077. ELECTRIC MOTOR. John D. Ihlder, Yonkers, N. Y.

514,078. ELECTRIC ELEVATOR MOTOR. John D. Ihdler, Yonkers, N. Y.

514,087, 514,088 and 514,089. ELECTRIC SHUTTLE MOTION FOR LOOMS. Levi W. Lombard, Lynn, Mass.

514,090. WATER-SUPPLY SYSTEM. Samuel D. Love, New York, N. Y.

514,109. ELECTRIC CAR TRUCK. Charles F. Winkler, Kingston, N. Y.

514,112. CLOSED-CONDUIT ELECTRIC RAILWAY. Frank W. Ashley, Hawthorne, N. J.

514,113. ELECTRIC RAILWAY. Frank M. Ashley, Hawthorne, N. J.

514,114. ELECTRIC-RAILWAY CONDUIT. Frank M. Ashley, Hawthorne, N. J.

514,115. ELECTRIC BATTERY. Frank Rayer, New York, N. Y.

514,120. ELECTRIC RAILWAY. Oscar A. Enholm, New York, N. Y.

514,128. SIGNALING SYSTEM. Joseph G. Noyes and Louis Winterhalder, Milford, Conn.

514,131. ELECTRIC METER. Carl Raab, Kaiserslautern, Germany.

514,133. UNDERGROUND ELECTRIC CONDUCTOR. Henry A. Seymour, Washington, D. C.

514,134. CLOSED CONDUIT FOR ELECTRIC RAILWAYS. Henry A. Seymour, Washington, D. C.

514,135. MOTOR-CONTROLLING DEVICE FOR ELECTRIC LOCOMOTIVES. Sidney H. Short, Cleveland, O.

514,139. ELECTRIC-ARC LAMP. Gustavus G. Wagner, New York, N. Y.

514,140. ALTERNATING DYNAMO. James J. Wood, Fort Wayne, Ind.

514,150. COMMUTATOR BRUSH. Jesse F. Kester, Buffalo, N. Y.

514,167. ELECTRICAL CONDUCTOR. Nikola Tesla, New York, N. Y.

514,168. MEANS FOR GENERATING ELECTRIC CURRENTS. Nikola Tesla, New York, N. Y.

514,170. INCANDESCENT ELECTRIC LIGHT. Nikola Tesla, New York, N. Y.

514,202. ELECTRIC ALARM. Friedrich Sauer and Carl Hentzchel, Berlin, Germany.

514,212. ELECTRIC SIGNALING DEVICE. James N. Connolly, New York, N. Y.

514,228. ELECTRICAL TRANSMISSION OF POWER. Rudolph M. Hunter, Philadelphia, Pa.

514,229. ELECTRIC ARC LAMP. Rudolph M. Hunter, Philadelphia, Pa.

514,241. MAGNETO-ELECTRIC MACHINE. Alward J. Potter, New Hartford, N. Y.

514,258. TEMPERATURE COMPENSATING DEVICE. William H. Bristol, Hoboken, N. J.

514,260. SECONDARY BATTERY. Hirman H. Carpenter, St. Louis, Mo.

514,267. ELECTRODE FOR SECONDARY BATTERIES. Jules Legay and Lucien Legay, Fils, Levallois, France.

514,274. ELECTRIC-TROLLEY-WHEEL SHIELD. Henry S. Pruyn, Hoosick Falls, N. Y.

514,275. METHOD OF AND APPARATUS FOR THE ELECTRO-DEPOSITION AND REFINING OF COPPER OR OTHER METALS. Lingan S. Randolph, Baltimore, Md

514,276. PROCESS OF ELECTROLYTIC SEPARATION OF NICKEL FROM COPPER. Pierre De P. Ricketts, New York, N. Y.

514,279. AUXILIARY FIRE-ALARM TELEGRAPH. Joseph Sachs, New York, N. Y.

514,297. SIGNALING APPARATUS. Edmund R. Wilder, New York, N. Y.

514,301. RHEOSTAT. John T. Birch, Pittsburg, Pa.

514,303. SERIES ELECTRIC RAILWAY. Michel A. Cattori, Rome, Italy.

514,305. ELECTROLIER. Edmund E. Clift, Philadelphia, Pa.

514,325. INSTRUMENT FOR MEASURING AND REGULATING ELECTRICAL RESISTANCES. George B. Lawrason, New Orleans, La.

514,361. AUTOMATIC ELECTRIC FIRE ALARM. William A. Guthrie, Durham, N. C.

514,362. FIRE ALARM AND SPRINKLER. William A. Guthrie, Durham, N. C.

514,398. ELECTRIC SIGNALING APPARATUS FOR RAILWAYS. Edgar C. Wiley, Bristol, Tenn.

514,425. ELECTRIC-ARC LAMP. William B. Luce, Brookline, Mass.

514,429. REGULATOR FOR ELECTRIC MOTORS. Sidney H. Short, Cleveland, O.